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A SEMI-MONTHLY ABSTRACT JOURNAL WITH INDEXES

JUNE 8, 1964

VOLUME 2 • NUMBER 11

N64-18514 — N64-19287

DOCUMENTS

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Scientific and Technical Aerospace Reports, Volume 2, is prepared by the Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget December 20, 1962

Introduction

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1. Scientific and technical reports of the National Aeronautics and Space Administration and its contractors.
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3. Scientific and technical articles prepared by employees of NASA and its contractors that appear in the learned and technical journals.

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Washington, D.C., 20546

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The public may purchase NASA documents listed in *STAR* from either of two sales agencies, as specifically identified in the abstract section:

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Scientific and Technical Information Division
National Aeronautics and Space Administration

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VOLUME 2 NUMBER 11

Scientific and Technical Aerospace Reports

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01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-18652 Smithsonian Institution, Washington, D.C. Science Information Exchange

AIR FORCE RESEARCH RESUMES 1963, VOLUME 4

Washington, Office of Aerospace Res. [1963] 584 p refs

(Contract AF 49(638)-1213)

(OAR-016, Vol. 4; AD-431950)

Résumés of current research efforts, (*not* publications) pertinent to the following areas are presented: organic chemistry; inorganic chemistry; physical chemistry and chemical physics; physical and chemical methods of analysis and measurement; metallurgy; solid-state sciences; experimental nuclear physics, particles, and cosmic radiation; theoretical physics; electric and magnetic properties; electric devices and networks; electromagnetic radiation and optics; physics of conducting fluids; information and control systems; energy conversion, transfer, and release; solid mechanics and structures; fluid mechanics; mathematics; earth physics; atmospheric physics and meteorology; space physics; behavior sciences; biological and medical sciences; research facilities; and consultants, conferences, and publications. I.v.L.

N64-18654 RAND Corp., Santa Monica, Calif.

SELECTION AND USE OF STRATEGIC AIR BASES

A. J. Wohlstetter, F. S. Hoffman, R. J. Lutz and H. S. Rowen Jun. 1962 410 p refs

(Contract AF 33(038)6413; Project RAND)

(R-266; AD-413271)

This study of strategic airbase systems consists of an examination of the critical factors in strategic-base selection, and application of this analysis to the basing of the 1956–1961 bombing force. The principal factors considered are the distances from bases to targets, to favorable entry points into enemy defenses, to the source of base supply, and to the points from which the enemy can attack these bases. The analysis is concerned with the joint effects of these factors on the costs of extending bomber radius; on how the enemy may deploy his forces, and the number of bombers lost to enemy fighters; on logistics costs; and on base vulnerability and probable loss of bombers on the ground. Several different airbase systems for the 1956–1961 strategic force have been compared to find the system of bases likely to give maximum striking power. E.W.

N64-18847 Canadair Ltd., (Canada)

MISSION SURVIVABILITY OF A MANNED AIRCRAFT SURVEILLANCE SYSTEM. VOLUME VIII: A MATHEMATICAL MODEL FOR THE VISUAL DETECTION OF LOW-FLYING AIRCRAFT

Nicholas Kurdyla Ft. Eustis, Va., Army Transportation Res. Command, Dec. 1963 56 p refs

(Contract DA 44-177-TC-793)

(ASP-1037; TRECOM-TR-63-67H; AD-434421)

This volume presents the derivation of a mathematical model for use in the determination of probability of visual detection of low-flying aircraft. The result is the factor $P(D/L_s)$, probability of visual detection given line of sight, which can be used in the general investigation of survivability of surveillance aircraft against visually aimed weapons. The mathematical formulation of the situation is based on geometrical concepts of a two-dimensional field, the known characteristics of the human eye, and an assumed technique of scanning by an observer. To determine the probability of visual detection in a given situation, a Monte Carlo approach, utilizing a digital computer, is proposed; the results, taken over a large number of random flight paths, would yield a probability of detection as a function of initially chosen parameters. Author

N64-19005 California U., Los Angeles Inst. of Geophysics and Planetary Physics

UCLA SPACE PROGRAM Quarterly Report, Period Ending July 31, 1963

W. F. Libby [1963] 96 p

The following studies in the physical sciences are discussed: (1) theoretical investigation of the constitution of the moon and planets, (2) particles and magnetic fields in space, (3) isotopic chemistry of meteorites, (4) high-pressure studies of the solid phases of inert gases, (5) the Summer Institute in planetary physics, (6) tropical cloud research in the Barbados area, (7) prelaunch activities with search coil magnetometer for the EOGO satellite, (8) fundamental problems in astronomy, (9) the organochemical composition of thucholite, (10) solid-state physics, (11) the earth's gravity field, (12) antenna calibration, (13) magnetohydrodynamics, (14) Mariner project, (15) effect of radiation on mutation rates, (16) tritium studies, (17) radiochemical studies, (18) ultraviolet investigation, (19) rare gas chemistry, (20) nuclear emulsion experiment utilizing flight of the X-15, (21) effects of pressure on magnetic interactions, and (22) the motions of particles. Studies in the fields of botany, psychology, zoology, engineering, and business administration that are related to the space program are also included. R.T.K.

N64-19077 Defence Standards Labs., Maribyrnong (Australia)

DEPARTMENT OF SUPPLY, DEFENCE STANDARDS LABORATORIES ANNUAL REPORT, 1962-63

[1963] 36 p refs

Research in the following areas is reported: (1) metallurgy—chromium base high temperature alloys, abrasion of metals, damaged layer in abraded germanium surfaces, long-term stability of nickel base thermocouple alloys, and correlation of anodic behavior and metallography of zinc alloy anodes, (2) physics—nuclear magnetic resonance, electron spin resonance, X-ray diffraction, conductivity anisotropy in silicon, measurement of length, calibration of analytical weights, performance testing of RADIAC (radiation indicating and computing) instruments, electron microscopy techniques, (3) chemistry—infrared and Raman spectroscopy, structural studies and stereochemistry of certain organic compounds, molecular structure and mass spectral patterns of organic compounds, activated charcoal from indigenous materials, detection and estimation of toxic gases and vapors, organotin compounds, oxygen in electrodeposited chromium, corrosion of lead in chromic acid solutions, photoconductivity and (4) miscellaneous research—including marine underwater coatings, ship trial for marine paints based on sodium silicate, fungal resistant paints, primary standard of force, measurement of compressive strength of materials, measurement of forces in the cold forming process, respiratory equipment, twisting apparatus for testing the terminal strength of fixed resistors, instrumental inspection of phosphorus smoke grenades, dilatometer induction heater, apparatus for static testing of two phase rocket motors, and fungicides for plastics.
R.T.K.

N64-19096 California U., Los Angeles Inst. of Geophysics and Planetary Physics
UCLA SPACE PROGRAM Quarterly Report, Period Ending Oct. 31, 1963
W. F. Libby [1963] 115 p refs

Among the research areas in which progress is reported are: (1) the development of spacecraft and rocket instruments with which to study magnetic and hydromagnetic phenomena in the magnetosphere and beyond, and the analysis of data obtained with such instruments; (2) the isotopic chemistry of meteorites; (3) high-pressure studies of the solid phases of inert gases; (4) a study of tropical cloud structure and patterning for meteorological and weather satellite data interpretation; (5) fundamental problems in astronomy; (6) the development of a crystal growing laboratory; (7) the derivation of formulas for the space gravity field of the earth in which an equipotential surface is a triaxial ellipsoid; (8) the reduction and analysis of magnetometer data from the Mariner II flight; (9) the effect of radiation on mutation rates; (10) the interaction of plasmas and plasma boundaries with high-frequency electromagnetic energy; (11) space biology; and (12) engineering research in space-related fields. Also, special reports concerning the Summer Institute in Planetary Physics, the working seminar on the geophysics of fallout, and the Astronautics Division are presented.
I.v.L.

N64-19176 Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
William M. Leak, ed. Dec. 1963 63 p refs
OTS: $1.25

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1. THE PROBLEM OF JET FUEL CONTAMINATION J. A. Krynitsky p 1–7 refs (See N64-19177 11-26)

2. TRANSMISSION OF LIGHT SIGNALS OVER THE HORIZON J. A. Curcio p 8–15 refs (See N64-19178 11-23)

N64-19258* National Aeronautics and Space Administration, Washington, D.C.
NASA PROGRAM PLANNING IN SPACE SCIENCES
Sep. 1963 718 p
(NASA TM X-51603) OTS: $31.00 ph

Detailed information is given on NASA-approved experiments and supporting research in the disciplines of astronomy, solar physics, planetary atmospheres, ionospheres and radio physics, particles and fields, planetology, and biosciences.
R.L.K.

N64-19261 Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
William E. Leak, ed. Feb. 1964 42 p refs
OTS: $1.25

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1. GALACTIC X-RAY ASTRONOMY S. Bowyer, E. T. Byram, T. A. Chubb, and H. Friedman p 1–6 (See N64-19262 11-05)

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N64-19264 Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Mar. 1964 44 p refs
OTS: $1.25

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1. THE RADIATION-INDUCED CHAIN REACTIONS BETWEEN NITROUS OXIDE AND HYDROGEN IN AQUEOUS SOLUTIONS C. H. Cheek and J. W. Swinnerton p 1–3 refs (See N64-19265 11-07)

2. A NEW SEARCH TECHNIQUE FOR ULTRASONIC INSPECTION OF SHEET STEEL S. D. Hart and L. C. Cardinal p 4–10 (See N64-19266 11-17)

N64-19272 Congress. House. Committee on Science and Astronautics
1965 NASA AUTHORIZATION Hearings Before the Committee on Science and Astronautics, U.S. House of Representatives, February 4-7, 1964
James E. Webb et al Washington, GPO, 1964 364 p
(88th Cong., 2d Sess., H. R. 9641, Pt. 1, Committee Print)
GPO: $4.00

Hearings were held before the Committee on Science and Astronautics of the United States House of Representatives on a bill to authorize appropriations to the National Aeronautics and Space Administration for research, development, and operation; for construction of facilities; and for other given purposes.
P.V.E.

N64-19273 Congress. House. Committee on Science and Astronautics
1965 NASA AUTHORIZATION Hearings Before the Subcommittee on Manned Space Flight of the Committee on Science and Astronautics, U.S. House of Representatives, February 18-20, 25-26, March 3, 10, 1964
George E. Mueller et al Washington, GPO 1964 979 p For abstract see N64-19272 11-01
(88th Cong., 2d Sess., H. R. 9641, Pt. 2, Committee Print)
GPO: $4.00

N64-19274 Congress. House. Committee on Science and Astronautics
1965 NASA AUTHORIZATION Hearings Before the Subcommittee on Space Sciences and Applications of the Committee on Science and Astronautics, U.S. House of Representatives, February 17-21, 25-28, March 2-3, 1964
Homer E. Newell et al Washington, GPO, 1964 690 p For abstract see N64-19272 11-01
(88th Cong., 2d Sess., H. R. 9641, Pt. 3, Committee Print)
GOP: $2.25

N64-19275 Congress. House. Committee on Science and Astronautics
1965 NASA AUTHORIZATION Hearings Before the Subcommittee on Advanced Research and Technology of the Committee on Science and Astronautics, U.S. House of Representatives, February 18-27, March 2-5, 1964
Edmond C. Buckley et al Washington, GPO 1964 837 p For abstract see N64-19272 11-01
(88th Cong., 2d Sess., H. R. 9641, Pt. 4, Committee Print) GPO: $2.75

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-18591 Army Missile Command, Huntsville, Ala. Advanced Systems Lab.
REAL GAS FLOW FIELD PROPERTIES AROUND BLUNT CONES, VOLUME II
B. Z. Jenkins 31 Dec. 1963 285 p refs
(RF-TR-63-18; AD-435488)

This report contains data on an equilibrium real-gas flow field passing over spherically blunted cones at zero degree and at five degrees angle-of-attack. The GASL 3-D characteristics program for the IBM-7090 computer was used to generate the data. The data given are pressure and enthalpy at points in the flow field. The wind coordinate system is used in the program. The coordinate D is a transformed R coordinate, such that D at the body surface is 0.0 and D at the shock wave is 1.000. The transformation is: $D = R - R_B / R_S - R_B$. The presentation of the tabulated data is in the following order: the zero angle-of-attack is given first for each different set of free-stream conditions and geometry; this flow field is axisymmetric and data are given for (D, Z) stations; this is followed by the angle-of-attack case in which data are tabulated beginning at the first Z station past the sphere cone junction; data are presented for (D, θ) points throughout the flow field. I.v.L.

N64-18602 ARO, Inc., Arnold Air Force Station, Tenn.
AN EXPERIMENTAL STUDY OF DIFFUSERS IN AN OPEN-JET, LOW-DENSITY, HYPERSONIC WIND TUNNEL
David E. Boylan Arnold Eng. Develop. Center Apr. 1964 71 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-47; AD-434380)

An experimental investigation of supersonic diffuser performance in a flow regime in which viscous and compressibility influences are equally important was conducted. The investigation involved Mach numbers from 6 to 16.5. It is shown that, although diffuser recovery compared to higher density regimes is small, using the proper diffuser allowed the required wind tunnel exhaust pressure to be up to 35 times the pressure existing in the test chamber. This was achieved in conjunction with Reynolds numbers on the order of 10^{-3} below those typical of tunnels yielding higher recoveries. For a given test condition, it was found that diffuser throat area was the dominant parameter in determining the increase in nozzle pressure ratio resulting from diffuser pressure recovery, with diffuser throat length becoming increasingly important with decreasing viscous effects, i.e., at higher Reynolds numbers. The change in pressure recovery created by the addition of a model in the stream also was investigated for a range of flow and diffuser condition. Author

N64-18644 Cook Electric Co., Chicago, Ill. Cook Research Labs.
DYNAMICS OF SEPARATING BODIES, VOLUME III: MEASUREMENTS AT MACH 8
R. D. Turner Holloman AFB, N. Mex., Office of Res. Analyses, Nov. 1963 61 p refs
(Contract AF 29(600)-1711)
(ORA-63-13; AD-433542)

Additional wind-tunnel tests at a Mach number of 8, which supplement Mach 2, 4, and 5 tests reported in Volume II, on a data capsule shape in an interference flow field of a carrier vehicle were conducted. The data obtained were analyzed, and a preliminary evaluation was made as to the agreement with methods of prediction for both the Mach 8 tests and previous reported tests. It is shown that where the interference flow field is reasonably predicted, estimated values of a capsule's derivatives obtained with relatively simple calculation techniques agree reasonably well with the data. Author

N64-18667 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SUPERSONIC EXPIRATION OF GAS OUT OF ASYMMETRIC VESSEL OF FINITE WIDTH DURING MAXIMUM EXPENDITURE
S. K. Aslanov (Saratov State U.) 17 Jul. 1963 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (USSR), no. 2, 1962 p 3-7
(FTD-MT-63-32/1+2; AD-434947)

A steady supersonic expiration of a stream of ideal adiabatic compressible gas out of an asymmetric vessel with parallel walls is considered. The fall of pressure, both outside and inside the vessel, is assumed large enough to insure maximum magnitude of gas expulsion. The solution of the boundary-value problem that arises for the region of mixed subsonic and supersonic flow is used to explain how the asymmetry of the walls of the vessel influences the angular displacement of the stream from its initial direction of flow. The effectiveness of a gas flap and of the steering mechanism working directly in the exhaust stream of a jet exit nozzle is considered. E.W.

N64-18699 Brown Engineering Co., Inc., Huntsville, Ala. Scientific Research Labs.
AN ITERATIVE METHOD FOR APPROXIMATING THE FLOW FIELD ABOUT A SUPERSONIC BLUNT BODY
Paul Nelson, Jr. Oct. 1963 45 p refs
(Tech. Note R-72; AD-435078)

An iterative method for approximating the inviscid flow field about a supersonic axisymmetric blunt body is described. The unique feature of the method is the use of a shock condition as the key in obtaining successive approximations. The method is not particularly suitable for obtaining results in closed form, but should be reasonably convenient for numerical computation. An approximation to the flow of an ideal gas about a sphere is obtained by applying a similar method to an approximate set of flow equations. Author

N64-18794 ARO, Inc., Arnold Air Force Station, Tenn.
EXPANSIVE FLOW TABLES PERTINENT TO JET FLOW CALCULATIONS
S. C. Lyons Arnold Eng. Development Center, Apr. 1964 313 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-73; AD-435470)

Charts and tables are presented for determining approximate values of the initial turning angles and the boundary shapes of jets exhausting to low ambient temperatures. The tables have been compiled to facilitate calculations pertaining to jet flow for various ratios of specific heats from 1.10 to 1.667 and Mach numbers from 1.0000 to 100.00. The ratios p/p_t and A/A^* and the Prandtl–Meyer angle are given for each Mach number and ratio of specific heats. Author

N64-18907 Massachusetts Inst. of Tech., Cambridge Aerophysics Lab.
SEPARATED FLOW ABOUT LIFTING BODIES [Final Report]
Leon H. Schindel Sep. 1963 109 p refs
(Contract N600(19)-58559)
(MIT-DSR-9221; MIT-AL-TR-80; AD-433818) OTS: $9.60

The flow over a lifting three-dimensional body is analogous to a time-varying two-dimensional flow. Satisfactory methods are available for computing the time-varying separated flow about an impulsively started cylinder provided the angular vortex separation points are known. The vortex separation points are determined primarily by the stability of the nonviscous flow. For practical calculations, the location of vortex separation may be assumed constant in time, and hence the steady-state values may be used. Calculations have been made of the viscous time-varying flow about a circular cylinder at low Reynolds numbers. Extension of calculations and applications of a stability criterion for the overall flow field offer methods for determining the angular position at which the feeding sheets leave the body on two-dimensional cylinders and conical noses. With the angular origin of the feeding sheets known, the axial location at which the separated vortices attain some small initial circulation is determinable, and computation of the vortex system is possible. Author

N64-18949* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TABLES FOR SUPERSONIC FLOW AROUND RIGHT CIRCULAR CONES AT ZERO ANGLE OF ATTACK
Joseph L. Sims Washington, NASA, 1964 428 p
(NASA SP-3004) GPO: $2.25

This report presents, in tabular form, the results of the calculation of supersonic flow fields about right circular cones at zero angle-of-attack. These calculations were performed using the Taylor and Maccoll theory. Numerical integrations were performed using the Runge–Kutta method for second-order differential equations. Results were obtained for cone angles from 2.5° to 30° in regular increments of 2.5°. A series of 16 problems were computed, at nominal free-stream Mach numbers from 1.5 to 20.0, for each of the 12 cone angles. The free-stream Mach number was not increased in even increments, but the same values were used for each cone angle. The desired free-stream Mach number was obtained to six or more significant figures in all calculations. The data listed in this report are essentially the same as those of Zdeněk Kopal's Tables of Supersonic Flow Around Cones. They differ from Kopal's work only in the manner of presentation and the use of a specific heat ratio of 1.4 instead of 1.405. I.v.L.

N64-18958* Boeing Co., Renton, Washington
DYNAMIC PRESSURE AND THRUST CHARACTERISTICS OF COLD JETS DISCHARGING FROM SEVERAL EXHAUST NOZZLES DESIGNED FOR VTOL DOWNWASH SUPPRESSION
C. C. Higgins and T. W. Wainwright Washington, NASA, Apr. 1964 81 p refs
(NASA Contract NASw-461)
(NASA TN D-2263) OTS: $2.00

Several exhaust-nozzle models were tested on a static rig using cold airflow to find the effect of exit design on thrust and jet-wake dynamic pressure for use in VTOL downwash suppression. Data from both free-jet and ground-plane tests are presented to define dynamic pressure along the jet-wake centerline and along the ground surface. Results show that three basic nozzle-design factors can be very effective in causing rapid dynamic pressure decay in the jet wake, with small effect on nozzle-velocity coefficient. Dynamic pressure profiles are compared throughout the mixing region for each nozzle and are shown to be similar. Author

N64-18961* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL DETERMINATION OF SODIUM VAPOR EXPANSION CHARACTERISTICS WITH INERT-GAS-INJECTION PRESSURE-MEASURING TECHNIQUE
Landon R. Nichols, Stanley M. Nosek, Charles H. Winzig, and Louis J. Goldman Washington, NASA, Apr. 1964 37 p refs
(NASA TN D-2276) OTS: $1.00

An inert-gas-injection technique was successfully used to measure accurately the static pressures of vaporous sodium expanding through an axisymmetrical convergent–divergent nozzle. Wall-pressure and axial-pressure profiles through the nozzle were determined. A search probe was actuated axially through the nozzle with a bellows seal to separate the sodium from the atmosphere. Comparison of the experimentally determined expansion characteristics of the metallic vapors with a theoretical one-dimensional isentropic expansion of a gas indicated that an expansion index n of 1.3 (from the law $pv^n = c$, where p is absolute pressure, v is specific volume, and c is a constant) best represented the experimental data over the range of nozzle inlet conditions investigated. Author

N64-19027 McGill U., Montreal (Canada) Mechanical Engineering Res. Labs.
A GENERALIZED METHOD FOR THE CALCULATION OF SUPERSONIC AND HYPERSONIC FLOW BEHIND CURVED SHOCK WAVES
Lung Yu Shih Jan. 1964 135 p refs
(Defence Res. Board Grant 9550-06)
(Rept. 64-2)

A method of calculating the performance of hypersonic air intake has been developed. The method is based on the equilibrium flow of a calorically imperfect gas. It is applicable to both axisymmetric and two-dimensional surfaces, the shape of which can be specified by a sixth-order polynomial. The method is applicable to both blunt and sharp leading edges. Boundary-layer calculations are included. Author

N64-19067 ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL DETERMINATION OF AERODYNAMIC DRAG ON A BLUNTED 10-DEG CONE AT ANGLES OF ATTACK IN HYPERSONIC, RAREFIED FLOW
David E. Boylan and William H. Sims Arnold Eng. Develop. Center, Apr. 1964 35 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-60; AD-435860)

Aerodynamic drag on spherically capped cones of 10° half-angle, with and without conical afterbodies, has been measured in hypersonic, low-density flow of nitrogen and argon. Reynolds numbers varied from 375 to 3,200, based on model characteristic length and free-stream conditions. Mach numbers were from 7.5 to 12.3. Angle-of-attack ranged from 0° to 40° and from 140° to 170°. Essential aerodynamic conditions of early entry into the atmospheres of Earth or Mars were simulated. Results have been compared with modified Newtonian and free-molecule calculations. Effects of hypersonic rarefied flow and

apparent, drag coefficients being as much as double the Newtonian value in spite of the very bluff shapes. A useful correlation procedure for a large class of similar bodies is suggested.
Author

N64-19185 United Aircraft Corp., East Hartford, Conn. Research Labs.
A SHOCK-EXPANSION METHOD FOR CALCULATION OF HYPERSONIC DYNAMIC STABILITY Quarterly Status Report No. 1, 29 Nov. 1963-28 Feb. 1964
Martin R. Fink Mar. 1964 37 p refs
(Contract NOw-64-0092-f)
(C-910188-4; AD-436694)

Equations for calculating hypersonic static and dynamic stability coefficients of airfoils and axisymmetric bodies are derived from the shock-expansion method. The calculated trends for sharp-nosed configurations are discussed. The damping in pitch of conical bodies is shown to increase as the hypersonic Mach number is increased. Methods are outlined for including the effects of nose bluntness, wing-planform shape, and wing-fuselage interaction.
Author

N64-19288 Canadian Armament Research and Development Establishment, Valcartier
A NUMERICAL METHOD FOR SOLVING THE INVERSE BLUNT BODY PROBLEM IN HYPERSONIC FLOW
D. P. Flemming Apr. 1964 30 p refs
(CARDE-TR-480)

A numerical method has been developed for computing the flow behind a given axially symmetric detached shock wave. Successive streamlines are constructed, each one closer to the stagnation streamline than its predecessor. Each streamline is terminated upon intersection with the positive Mach line passing through the outermost shock data point. A number of comparative solutions have shown excellent consistency in the subsonic region and in a reasonable portion of the supersonic region.
Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see:* 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-18911 Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
DETERMINISTIC PREDICTIONS OF THE MOTIONS OF A HYDROFOIL CRAFT IN IRREGULAR SEAS
R. P. Bernicker Jan. 1964 29 p refs
(Contract NObs-88186)
(R-1003; AD-436567) OTS: $2.60

The heave and pitch response-time histories of a fully wetted surface-piercing dihedral hydrofoil craft in irregular head seas were calculated from theoretical considerations, using the concept of the impulse-response function. This function, the Fourier transform of the transfer function, was used in a convolution-type integral with the actual measured-wave time history to give a point-by-point deterministic prediction of the longitudinal motions. Comparison with experimental records indicates that the method yields a satisfactory approximation to the actual motion similar to that previously attained with surface ships and fully submerged bodies, and that it further substantiates the linearity of a hydrofoil craft wave system.
Author

N64-19295 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
INVESTIGATION OF JET CONTROL SURFACES [UNTERSUCHUNG VON STRAHLRUDERN]
A. Hammer and R. Jahn (Bolkow-Entwicklungen K.G.) London, Min. of Aviation, Oct. 1963 24 p refs
(RAE-TRANS-1049)

Experimental and theoretical studies are described for control surfaces in a supersonic jet ($M_E = 3$) with simulated external flow. Nozzle shape and external pressure near the jet exit were studied; and investigations were made of the effects on control surface efficiency of the distance of the control surface from the jet exit, and of the geometry and form of the control surface.
Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see:* 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-18706 Flight Sciences Lab., Inc., Buffalo, N.Y.
A GENERAL INVESTIGATION OF HYPERSONIC STABILITY AND CONTROL UNDER TRIMMED FLIGHT CONDITIONS First Quarterly Technical Report
4 Mar. 1964 71 p
(Contract NOw 64-0201-c)
(R-63-011-104; AD-434804)

This report demonstrates that under the assumptions of Newtonian theory, simple analytic equations can be derived for all the important aerodynamic stability derivatives as a function of angle-of-attack. The derivatives are determined considering longitudinal- and lateral-directional motion separately. Both static and damping derivatives are analyzed. It is shown that the analytic form the derivatives assume is independent of the particular aerodynamic shape considered. Only the constants in the equations are a function of the shape. General integral relationships are developed for determining these constants. The general methods developed are applied to the determination of the static stability derivatives of a cone.
Author

N64-18716 Advisory Group for Aeronautical Research and Development, Paris (France)
INVESTIGATIONS ON THE DYNAMIC STABILITY OF PERSONNEL GUIDE SURFACE PARACHUTES
R. Ludwig and W. Heins (Deutsche Forschungsanstalt für Luft- und Raumfahrt) Apr. 1963 27 p refs Presented at 22nd Meeting of Flight Mech. Panel, Torino, Italy, 16–19 Apr. 1963
French summary
(AGARD-444)

In order to investigate the dynamic stability of a parachute, the system of the nonlinear equations of motion is derived. In contrast to previous contributions, this system of differential equations is not linearized, but is integrated by electronic

computers for a number of examples of personnel guide surface parachutes. The influence of the suspension line length, the effective porosity of the canopy, the weight of the load, and the apparent mass on the dynamic behavior are studied for the examples chosen. The results show that the oscillations of parachutes cannot be described by linearized equations of motion. For instance, only the nonlinear procedure enables the complete description of the velocity oscillations. Furthermore, it becomes evident that frequency and damping depend on amplitude. For some amplitudes the square of the oscillation period is proportional to the length of the suspension lines. With increasing porosity of the canopy, the damping increases, and the oscillation period decreases. Author

N64-19136 Bell Helicopter Co., Fort Worth, Tex.
JOINT ARMY-NAVY AIRCRAFT INSTRUMENTATION RESEARCH (JANAIR) Technical Progress Report
D. E. Rosenquist, E. V. Mc Dowell, H. W. Upton, and D. J. Dougherty Jul. 1963 73 p refs
(Contract Nonr-1670(00))
(D228-100-008; AD-435733)

The status of the engineering testing and systems design for the (RH-2) Research Helicopter Number Two is discussed. A collection of oral reports given to the JANAIR Committee in July 1963 is included. A description of evaluative studies is presented with performance data and brief results and conclusions for the RH-2 vertical display, navigation display map scales, and television flight displays. Author

N64-19229 Entwicklungsring Nord, Bremen (W. Germany) Weser Flugzeugbau
A SYSTEMS ANALYSIS OF REMOTE-CONTROLLED STABILIZED FLYING BODIES [ZUR SYSTEMANALYSE FERNGELENKTER STABILISIERTER FLUGKORPER]
Jürgen Schindelin [1963] 50 p refs In GERMAN

The stabilizing system consists of: (1) a steering commando receiver; (2) a flight-program storage; (3) a reference system consisting of three single-axis integrated gyrostabilizers; (4) adjustment networks for preventing instability caused by marked changes in the system parameter of the flying body as a function of the flightpath; (5) hydraulic systems for swinging (tilting) the three engines to change the direction of the thrust vector; (6) a velocity gyrostabilizer in the loop of the restoring mechanism; and (7) compensation systems for the flying-body kinematics. Discussed are: (1) a gyrostabilizer with one degree-of-freedom; (2) the adjustment networks; (3) engine swinging (tilting), which includes an analysis of hydraulic systems in nonrotating and rotating flying bodies; (4) the determination of the components of the thrust vector; (5) the determination of the moments of thrust; (6) elastic structural vibrations; (7) the total motion of a structural element; (8) axes alignment of the various gyrostabilizers; (9) equations of motion for these stabilizers; (10) input signals and compensation systems for swinging (tilting) the engines; and (11) the derivation of the steering-control equation. Analog computer simulation of the exact equations or of the compensation systems easily permits a representation of nonlinearities such as threshold values and "blind spots." I.v.L.

N64-19230 Dornier-Werke G.M.B.H., Friedrichshafen (W. Germany)
ANALYSES OF TIME OPTIMIZATION OF TRANSITION FLIGHT OF VTOL-AIRCRAFT [BETRACHTUNGEN ZUM ZEITOPTIMALEN UBERGANGSFLUG VON VTOL-FLUGZEUGEN]
H. Friedel 18 Sep. 1963 26 p refs In GERMAN Presented at the Meeting of Wiss. Gesellschaft für Luft- u. Raumfahrt, Munich, 1963
(Rept. 5104-101/789)

Possible solutions for calculating time-optimum transition flight with respect to three groups of boundary conditions were investigated. The problem of optimum pullup to a predetermined flight altitude, with the boundary conditions of a given initial velocity and a given angle-of-position for the end of the pullup flight path, was programed for the IBM 1620 computer, with particular emphasis on VTOL aircraft having a swingable thrust vector. Calculations were based on a hypothetical 5-ton aircraft. Diagrams are presented that illustrate the effect of the angle-of-position at the end of the pullup flight path and of the flight altitude on the flight path, optimum times, and control functions for the angle-of-attack and for the horizontal swing of the engines. For comparative purposes, calculations were made for the same aircraft when the angle-of-attack was as large as possible and when the horizontal swing of the engines was possibly tangential to the flight path. The results obtained in this investigation can be applied to more complex combinations of lifting and thrust engines when larger and faster electronic computers are available. Trans. by I.v.L.

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-19168* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
ON THE APPLICATION OF PFAFF'S METHOD IN THE THEORY OF VARIATION OF ASTRONOMICAL CONSTANTS
Peter Musen Washington, NASA, Apr. 1964 30 p refs
(NASA TN D-2301) OTS: $0.75

Cartan's integral invariant is used as a foundation for the theory of variation of astronomical parameters. The differential equations for the general perturbations are obtained as the first system of Pfaffian equations associated with the linear differential form appearing in the integral invariant. The equations for general perturbations of the Gibbsian unit vectors, of the Gibbsian rotation vector, and of Euler's parameters are derived. The utilization of the Gibbsian rotation vector represents an extension of Stromgren's and of the author's ideas on special perturbations to the problems of general perturbations. Euler's parameters find their application in Hansen's lunar theory. The case of redundant elements is treated by introducing constraints and Lagrangian multipliers. Cartan's integral invariant expressed in terms of vectorial kinematic elements is a powerful tool in the search for new sets of elements and leads to compact equations. Author

N64-19262 Naval Research Lab., Washington, D.C.
GALACTIC X-RAY ASTRONOMY
S. Bowyer, E. T. Byram, T. A. Chubb, and H. Friedman *In its* Rept. on NRL Progr. Feb. 1964 p 1-6 (See N64-19281 11-01) OTS: $1.25

An X-ray proportional counter was used to search the sky from an Aerobee rocket launched at White Sands Missile Range. Two discrete X-ray sources are identified, one in the Scorpius constellation and one in the Crab Nebula. These sources may be neutron stars. A general diffuse radiation was observed that may be of galactic or extragalactic origin. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-18567 General Electric Co., Schenectady, N.Y. Electronic Components Div.
EVALUATION OF A MOLYBDENUM EMITTER, LOW VOLTAGE ARC THERMIONIC POWER CONVERTER Final Report
E. A. Baum Wright-Patterson AFB, Ohio, Aeronautical Systems Div., Feb. 1963 105 p ref
(Contract AF 33(657)-8323)
(ASD-TDR-63-183; AD-402844)

Results of life tests on the planar molybdenum-emitter cesium-vapor thermionic converter operating under steady-state conditions are presented along with a description of the life-test equipment. Transient data on the effect of variations in cathode, anode, and reservoir temperatures, as well as step changes in the load, are also presented. The steady-state life tests were performed at a cathode temperature of 1,450° C on a 5 cm^2 cathode area converter design with the thermal input being supplied by a radiation-type furnace in order to more closely simulate solar cavity heating. Seven converters were tested for extended periods with nominal power outputs of 1.5 w/cm^2 to 2.5 w/cm^2. The maximum life of the state-of-the-art structure on one converter was in excess of 3,000 hr, and four converters were operated beyond 1,000 hr without major degradation in the power output. Author

N64-18587 Aero Geo Astro Corp., Alexandria, Va.
STANDARD POWER SUPPLY MODULES Final Report
Johnsville, Pa., Naval Air Develop. Center, 12 Jun. 1963 120 p
(Contract N62269-1448)
(NADC-EL-6322; AD-412597)

The report has been prepared to provide supporting data for the development and standardization of modules and related cooling requirements, fabrication of modules, and the design and development of modules in the form of repairable packages. A general discussion of background material is presented that outlines the intent, development, design, and philosophy of areas that were involved in the design, development, and construction of Standard Modules in accordance with MIL-E-19600A. A detailed description is given of the design, development, fabrication, and test of the modules. The tests performed on the modules are described in detail, and a photograph of each module is included to show the techniques used to achieve the various results. Author

N64-18610 Magna Corp., Anaheim, Calif. Research and Development Div.
BIOCHEMICAL FUEL CELLS Sixth Quarterly Progress Report, 1 Oct. 1963-31 Dec. 1963
W. R. Momyer and H. P. Silverman [1963] 41 p refs
(Contract DA-36-039-SC-90866)
(AD-434713)

The electrooxidation of formic acid was investigated under conditions compatible with, but independent of, biological systems. Current densities near 10 ma/cm^2 at polarizations less than 0.25 v were consistently obtained with formic acid under these experimental conditions. The effects of temperature, electrode catalyst, pH, and fuel concentration on the electrochemical performance of this electrode are reported. The electrochemical behavior of the *E. coli*-glucose and the *E. coli*-pyruvate systems (formic acid bioelectrodes) were investigated using dispersed suspensions of the bacteria. Current densities of 5 ma/cm^2 at polarizations near 0.25 v were obtained with these bioelectrochemical systems. Thus, the rate of biological generation of formic acid is presently limiting the current output in both of these systems. Author

N64-18707 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Labs. for Pure and Applied Science
RESEARCH ON THERMIONIC CELL COLLECTORS Summary Report, 1 Nov. 1962-31 Oct. 1963
B. Rump, C. W. Savery, Jr., J. H. Broido, J. C. Peak, and W. B. Wright, Jr. 15 Jan. 1964 180 p refs
(Contract NObs-86221; ARPA Order 219-61)
(GA-4804; AD-432250)

Collector surfaces and thermionic networks were studied during this period. The collector surface investigations centered around the work functions of cesiated surfaces and surfaces coated with cesium hydride. Surface properties have been controlled to give consistently reproducible results. The work-function-lowering effect of hydrogen addition has been proven, and increased output of a cell due to hydrogen addition has been demonstrated. A new cell has been devised for examining actual generator performance. The thermionic network studies consisted of comparisons of liquid-metal-cooled and water-cooled thermionic reactor systems. The nuclear, thermionic, and thermal properties of each system were considered, and the results are presented in several tables. E.W.

N64-18749 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BROADENING OF REGION OF STABLE WORK OF A STAGE OF AN AXIAL COMPRESSOR
V. N. Ershov, Yu. V. Pavlenko et al (Kharkov Aviation Inst.) 17 Jul. 1963 14 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 2, 1962 p 41-44
(FTD-MT-63-33/1+2; AD-434944)

The most convenient and simple-to-construct means for broadening the stability region of a compressor stage is by the injection of flow through an annular slot in front of the compressor stage. On the test stage, injection of air under pressures 2 to 3 times that of the stage succeeded in displacing the boundary by 25% to 30%, and in lowering the maximum energy of pulsation in the zone of disruption by 40%; the quantity of compressed air was 25% above the minimum expenditure, thus insuring stability. Additional experimental research showed that the effect of air injection on the stability of all stages was not identical. Author

N64-18908 Gulton Industries, Inc., Metuchen, N.J. Akaline Battery Div.
DESIGN, FABRICATION, AND TESTING OF SEALED, RECHARGEABLE SILVER-CADMIUM CELLS Second Quarterly Progress Report, 1 Oct.-31 Dec. 1963
G. M. Apgar [1963] 19 p
(Contract DA-36-039-AMC-03358(E))
(AD-434061) OTS: $2.60

Quotations for all detail parts to be purchased have been delivered, and all parts ordered. All standard hardware has been delivered. Samples for evaluation of all special parts, except containers and covers, have been received. Preliminary testing of prototype cells, type 1 through 4, has been completed. Author

N64-18933 Systems Technology, Inc., Inglewood, Calif.
ANALYSIS OF MULTILOOP VEHICULAR CONTROL SYSTEMS
D. T. Mc Ruer, I. L. Ashkenas, and H. R. Pass Wright-Patterson AFB, Ohio, AF Flight Dynamics Lab., Mar. 1964 113 p refs
(Contract AF 33(616)-8024)
(ASD-TDR-62-1014; AD-434799)

The multiloop vehicular control-system-analysis technique is designed to maximize the transfer to the multiloop problem of knowledge and insights obtained from elementary single-loop vehicular control-system analyses. The matrices representing the closed-loop multiloop system are expanded in a special fashion to forms in which the elementary single-loop systems explicitly appear. In the course of the development, the concept of the vehicle coupling numerator is introduced as an additional property of vehicle response behavior. The overall closed-loop system analysis consists of successive closures of single, elementary system loops and loops involving vehicle transfer-function numerators and coupling numerators. The method is developed initially using a general multiloop system. Two simple, practical multiloop systems in aircraft control are then used as examples of the analysis technique; one illustrates a multiloop situation utilizing a single vehicle control input, and the other involves multiloop control using two vehicle control inputs. Author

N64-18934 Aerospace Medical Div., Aerospace Medical Research Labs., (6570th), Wright-Patterson AFB, Ohio
REMOTE VIEWING: A COMPARISON OF DIRECT VIEWING, 2D AND 3D TELEVISION Technical Documentary Report, Jan.-Jul. 1963
William N. Kama and Roger C. DuMars Feb. 1964 13 p refs
(AMRL-TDR-64-15; AD-436015) OTS: $0.50

The effect of three viewing conditions (direct, 2D television, and 3D television) upon performance of a simple remote-handling task was investigated. Fifteen subjects used a CRL Model 8 master-slave manipulator to perform a shortened and revised version of the Placing Subtest of the Minnesota Rate of Manipulation Test. All subjects performed the task under each of the viewing conditions employed. Results of this study indicated that: (1) subject performance under the direct viewing condition was significantly faster than that obtained under either of the video conditions, and (2) no significant differences were noted between the two video conditions even though performance times under the 2D condition were initially longer than those obtained under the 3D condition. Author

N64-19056 Battelle Memorial Inst., Columbus, Ohio
MULTIFUELED THERMAL-ENERGY-CONVERSION SYSTEMS Quarterly Progress Report No. 6, 1 Oct.-31 Dec. 1963
H. R. Hazard, D. E. Roop, and J. D. Hummell [1963] 28 p refs
(Contract DA-36-039-SC-90838)
(AD-435857)

Study of small steam boilers of minimum size and weight for a solid-fuel-fired 150-w power source was continued. Satisfactory combustion and efficiency were obtained with a unit weighing 2.54 kg. Evaluation of an ultrasonic atomizer for a multifuel liquid-fueled burner was begun. Atomization of gasoline and of No. 2 heating oil was similar over a range of flow rates. Author

N64-19062 Eagle-Picher Co., Joplin, Mo. Couples Dept.
RESEARCH ON AMMONIA BATTERY SYSTEM Report No. 14 (Second Quarterly Progress), Oct. 1, 1963-Dec. 31, 1963
D. J. Doan 31 Jan. 1964 20 p refs
(Contract DA-36-039-AMC-02173(E))
(AD-435008)

Fractional factorial studies of improved cell design have resulted in isolation of main effect factors, and research is being continued for more complete evaluation. Design improvements have significantly increased cell efficiency and reliability. These cell improvements have yet to be incorporated into battery design to check their effect on performance. Author

N64-19081 Little (Arthur D.), Inc., Cambridge, Mass.
LOW TEMPERATURE OPERATION OF BATTERIES Quarterly Report No. 5, 15 Sep.-14 Dec. 1963
R. A. Horne and David L. Richardson [1963] 32 p refs
(Contract DA-36-039-SC-90706)
(AD-433871)

Common Leclanche cells can deliver currents in the hundred microamp range even at very low temperature (−55° F). Measurements of the thermal masses of batteries indicate that they can be approximated by the thermal masses of their constituent cells. The advantage in weight capacity (watt-hr per unit weight relationship) of an insulated battery to be gained by increased thickness of insulation begins to level off at about 0.6 in. for expanded polystyrene. Analysis shows that for a given insulation there is a maximum attainable fraction of the +70° F volume capacity (watt-hr per unit volume relationship). For short missions this maximum is approached by thin insulation and for long missions by thick insulation. The effect of initial battery and ambient temperatures on weight capacity has been examined. The attainable fraction of the +70° F weight capacity increases rapidly with increasing battery thermal mass but tends to level off at higher masses. The effect of the thermal conductivity of the insulation on the weight capacity has also been examined. Author

N64-19165 Bell Telephone Labs., Inc., Whippany, N.J.
NIKE-ZEUS CRYOSTATS
Michael A. Glagola and Robert F. Jarrell 2 Dec. 1963 28 p refs
(AD-425398)

Refinements in existing cryostats are needed before they can be used in Nike-Zeus. Simple design, small size, high reliability, and simplified maintenance and operation are the program's goals. A life expectancy of 50,000 hours is needed, and, so far, only 2,000 hours of life have been reached. Contamination of the helium and cool-time reduction are two other problems that are being solved. G.D.B.

N64-19206 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TAPCO Div.
LONG-LIFE THERMIONIC CONVERTERS FOR SOLAR POWER SYSTEMS Final Report
Wright-Patterson AFB, Ohio, ASD, Feb. 1963 91 p refs
(Contract AF 33(616)-8114)
(ASD-TDR-62-1069; AD-299004)

This report describes the work accomplished under an applied research program directed toward increasing the cycle life of thermionic converters that can be used in solar thermionic generators. The results of cycle life tests of five thermionic converters, and the results of a solar test of a cavity-type thermionic generator, which used five converters identical to the life test converters, are presented. A complete discussion of all specialized equipment and techniques is also included, along with design details. The life tests demonstrated that converters have operating life capabilities under cyclic conditions of 596 hr. The solar test program has shown that good correlation can be had with laboratory test results. Author

N64-19223* Union Carbide Corp., Parma, Ohio Parma Research Lab.
STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES 3rd Quarterly Report, 2 Jan.-31 Mar. 1964
M. L. Kronenberg 1 Apr. 1964 22 p
(NASA Contract NAS3-2752)
(NASA CR-54031) OTS: $2.60 ph

There were no significant performance differences between cells operating on interrupted d.c. or a.c. superimposed on d.c. at frequencies from 20 cps to 20 kcps and control cells operating at continuous d.c. The peak value of the superimposed a.c. was less than the d.c. level. Improvement in the average performance of thin, composite cells up to 100 mv at 150 ma/cm^2 was noted when electrodes were subjected to heavy discharge pulses of short duration. Except for "breaking-in" phenomena, the effect has been observed only at the anode and generally is most pronounced for anodes with more than 100-mv polarization. Experiments involving the mechanical motion of 1/4-inch carbon, thin composite, and metal electrodes have been completed at frequencies ranging from 20 to 300 cps. In no instance did the cell voltage change by more than several millivolts as a result of the vibrations. Experiments involving the sonic pulsing of electrolyte did not reveal any significant effects on cell performance resulting from the pulsations. Author

N64-19245 General Electric Co., Pleasanton, Calif.
RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY Third Quarter Report, 1 Nov.-31 Dec. 1963
J. E. Van Hoomissen 31 Dec. 1963 6 p refs
(Contract NObs-88578; ARPA Order 219)
(AD-430112)

Technical progress is reported in the following areas: (1) emitter–collector spacing development task, (2) emission-shield development task, (3) UO_2 refractory-metals reaction kinetics task, (4) insulator-materials development task, and (5) high-temperature metal-to-ceramic seals—cesium resistant metalizing, active-alloy sealing, metal-to-metal joining, and cesium corrosion testing. R.T.K.

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-18617 Wyandotte Chemicals Corp., Mich. Polymer Research Dept.
SYNTHESIS OF LOW TEMPERATURE OIL RESISTANT URETHANE ELASTOMERS Quarterly Progress Report No. 5, 1 Oct. 1963-31 Dec. 1963
S. L. Axelrood and W. G. Lajiness 31 Dec. 1963 23 p
(Contract DA-20-018-ORD-24883)
(AD-430459)

Urethane–urea cast elastomers were prepared by the one-shot casting technique from four experimental polyether polyols. These polyols included two triols, Mol. Wt. = 14,000 and 15,000, and two diols, Mol. Wt. = 7,000 and 8,000. Elastomers formed from the 14,000 Mol. Wt. triol, dichlorobenzidine (DBC), and toluene diisocyanate (TDI), at various proportions of amine to hydoxyl groups, using stannous octoate as a catalyst, had low mechanical strength. Improved elastomers were obtained from this polyol by blending with trimethylol propane in various proportions; these elastomers had better oil resistance and tensile strength. Elastomers prepared from the 15,000 Mol. Wt. triol were quite similar to the samples based on the 14,000 Mol. Wt. triol. Samples were also prepared using blends of 7,000 or 8,000 Mol. Wt. diols with trimethylol propane. The resulting elastomers had a lower durometer hardness for equivalent tensile strength values, but were generally similar in other characteristics to the elastomers prepared from the triols. Also, a high-molecular-weight urethane–polyether plasticizer was prepared by reacting the 7,000 Mol. Wt. diol with the stoichiometric weight of TDI. This plasticizer was combined with the polyol–diamine blend to prepare one-shot casting using 5, 10, and 20 parts of the plasticizer in the final polymer. Improved low-temperature flexibility resulted. I.v.L.

N64-18626 Temple U., Philadelphia, Pa. Research Inst.
ADDITION AND SUBSTITUTION PRODUCTS OF OXYGEN FLUORIDES Fourth Annual Progress Report, 1 Jan.-31 Dec. 1963
A. G. Streng and A. V. Grosse 17 Jan. 1964 59 p refs
(Contract Nonr-3085(01))
(AD-435838)

A new method for the preparation of oxygen fluorides is described; it consists of passing an electric spark discharge in liquid fluorine and oxygen at low temperatures. The reaction products are immediately quenched by the cold liquid. Reaction of OF_2 with Xe, both by thermal or electric discharge methods, led to xenon oxyfluorides. Reaction of O_2F_2 with XeF_4 led to XeF_6 and O_2. The first krypton fluoride, KrF_4, was synthesized, and some of its physical and chemical properties determined. It was found that it acts as an efficient catalyst to promote the decomposition of O_2F_2 to O_2 and F_2. The preparation of a thermally stable and insoluble xenon acid salt, barium xenate (Ba_3XeO_6), and a new volatile acid of xenon are described. An acid of krypton and the barium salt of this acid have been produced; the barium salt of this krypton acid is thermally stable and insoluble in water. Author

N64-18628 Hercules Powder Co., Wilmington, Del. Research Center
A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE $-NF_2$ GROUP First Annual Report, Mar. 1963-Feb. 1964
A. D. Craig, M. M. Anderson, J. C. W. Chien, G. A. Ward, and C. M. Wright 15 Apr. 1964 107 p refs
(Contract DA-31-124-ARO(D)-62; ARPA Order 402)
(HRC-64-1; AD-435490)

The goal of this program is a more complete understanding of the electronic configuration and the chemical behavior of the N-F species. The electrochemical reaction of HNF_2, N_2F_2, and N_2F_4 was investigated using both microscale techniques, such as polarography, cyclic voltammetry, chronopotentiometry, and coulometry, and macroscale electrolyses in which the products of the reaction can be separated and identified. The interaction of a series of simple NF_2 compounds with some Lewis acids has also been studied. The difluoramines are NF_3, N_2F_4, HNF_2, $ClNF_2$, CF_3NF_2, $C_2H_5NF_2$, CH_3NF_2, and CD_3NF_2 and the Lewis acids are BF_3, BCl_3, PF_5, and SO_2. The calculation of stabilities of hypothetical salts containing NF species by semi-empirical methods is described. R.T.K.

N64-18631 Frankford Arsenal, Philadelphia, Pa. Pitman Dunn Inst. for Research
HYDROLYSIS OF HEPTAFLUOROPROPYLPHOSPHONOUS DIIODIDE AND BISHEPTAFLUOROPROPYLPHOSPHINOUS IODIDE. FORMATION OF BISHEPTAFLUOROPROPYLPHOSPHINE
Maurice Codell Repr. from J. Chem. Eng. Data, v. 8, no. 3, Jul. 1963 p 460 ref
(A63-14; AD-425763)

Reaction of heptafluoropropylphosphonous and bisheptafluoropropylphosphinous iodides with dimethylamine gave the corresponding N,N-dimethyl amides. Hydrolysis of the acid iodides, or treatment with solid alkali, gave the previously unknown bisheptafluoropropylphosphine. Author

N64-18782 Ozark-Mahoning Co., Tulsa, Okla.
SYNTHESIS OF NEW FLUORINE CONTAINING COMPOUNDS Quarterly Technical Summary Report, 1 Jan.-31 Mar. 1964
8 Apr. 1964 10 p refs
(Contract AF 04(611)-9556; ARPA Order 24, Amend. 65)
(AD-434866)

Investigations of the following groups of reactions, with emphasis placed on the composition of the solid phases, were conducted: (1) Alkali metal nitrates and nitrites with fluorine and chlorine trifluoride—conversion to the fluoride occurs if fluorine is used and to the tetrafluorochlorate if ClF_3 is used. (2) Oxides and fluoroxides of nitrogen with cesium fluoride—in general, no reaction takes place; however, in the case when NO_2 is in large excess, there is a conversion of the fluoride to the nitrate. (3) Alkali metal fluoride, alkaline-earth fluorides, NO, and FNO with chlorine trifluoride—cesium, rubidium, and potassium fluorides with ClF_3 give the tetrafluorochlorate in yields ranging from 94% to 100%. The other starting materials either do not react or give no solid product. Author

N64-18802 National Bureau of Standards, Washington, D.C.
RECENT MICROWAVE SPECTRA STUDIES OF HIGH TEMPERATURE SPECIES
David R. Lide, Jr. *In* APL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 1–2 (See N64-18801 11-13)

A high-temperature spectrometer was constructed and used to investigate the microwave spectra of AlF and AlCl. The investigated species were produced by reduction of the trihalides with aluminum metal at a temperature of 600° to 700° C. The AlF and AlCl spectra were typical of diatomic molecules; the transitions were identified with complete certainty by measurement of nuclear quadrupole hyperfine structure and Stark effects. The molecular constants are presented in tabular form. The spectrum of LiCl was also measured and analyzed, and results are presented in tabular form. P.V.E.

N64-18803 Ohio State U., Columbus Cryogenic Lab.
APPLICATION OF THE TECHNIQUE OF MATRIX ISOLATION TO THE STUDY OF INFRARED SPECTRA AND THE STRUCTURES OF INORGANIC MOLECULES STABLE AT ELEVATED TEMPERATURES
David White *In* APL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 3–10 refs (See N64-18801 11-13)
(Contract Nonr-495(12))

The analysis of the infrared-absorption spectra of several inorganic molecular species trapped in solid rare-gas matrices is discussed. The interpretation of these spectra, to establish frequency assignments and the molecular symmetries, depends on the assumption that the vibrational isotopic shifts of trapped species are the same as those of the free molecules. The validity of this assumption is examined by a comparison of the gas-phase infrared spectra of some simple molecules with their matrix spectra. Author

N64-18804 General Electric Co., King of Prussia, Pa. Space Sciences Lab.
SOME RECENT INFRARED SPECTRA OF THORIA, ZIRCONIA AND HAFNIA BY MATRIX ISOLATION
Milton J. Linevsky *In* APL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 11–20 refs (See N64-18801 11-13)

The infrared spectra of several high-temperature molecules, vaporized from thoria, zirconia, and hafnia, have been observed using the technique of matrix isolation. Such molecules as ThO_2, ThO, ZrO_2, ZrO and HfO have recently been observed. A linear model for ThO_2 and ZrO_2 is consistent with the observed frequencies, and tentative assignments for these molecules have been made. No evidence for the HfO_2 molecule was found. The fundamental vibrational frequencies for ThO, ZrO, and HfO were established. Author

N64-18805 IIT Research Inst., Chicago, Ill.
INFRARED SPECTRA BY MATRIX ISOLATION OF SOME LOW-MOLECULAR-WEIGHT INORGANIC COMPOUNDS
Alan Snelson *In* APL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 21–26 refs (See N64-18801 11-13)

The recently developed matrix-isolation technique is being used to obtain spectral data for the high-temperature vapor species of some low-molecular-weight inorganic functions. The equipment used is similar to that used by Snelson and Pitzer. G.D.B.

N64-18807 Vanderbilt U., Nashville, Tenn.
ULTRAVIOLET SPECTROSCOPY
K. Keith Innes *In* APL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb 1964 p 31–33 (See N64-18801 11-13)

A brief description of spectrographs commonly used in ultraviolet spectroscopy is presented along with a list of sources of radiation from molecules of interest. Two case histories are given to illustrate the power and the limitations of the spectroscopic approach to the identification and detailed characterization of unstable species. P.V.E.

N64-18808 National Bureau of Standards, Washington, D.C.
X-RAY STUDY OF 1-ETHYLDECABORANE
Alvin Perloff *In* APL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 35–41 refs (See N64-18801 11-13)

The molecular structure of 1-ethyldecaborane has been established by single-crystal X-ray analysis. The compound crystallizes in the orthorhombic system, with cell dimensions a = 10.11, b = 14.40, and c = 7.28 A. The space group is $P2_12_12_1$, and the unit cell contains four molecules of $B_{10}H_{13}C_2H_5$. The compound is a simple substitution derivative of decaborane, and no significant distortion of the decaborane configuration is induced by the substitution. Author

N64-18815 Argonne National Lab., Ill.
A NOTE ON THE FRAGMENTATION PATTERN OF LiF
J. Berkowitz *In* APL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 121–122 refs (See N64-18801 11-13)
(Supported by AEC)

Double-oven experiments performed in an attempt to deduce the mass spectral-fragmentation pattern of various $(LiF)_n$ molecular species have resulted in a general lack of agreement in the results obtained. An attempt to clarify this disagreement is presented as are arguments for the acceptance of one set of results over the other. P.V.E.

N64-18858 AeroChem Research Labs., Inc., Princeton, N.J.
CHEMI-IONIZATION
A. Fontijn *In* Va. U. Project Squid 1 Apr. 1964 p 31–34 refs (See N64-18851 11-24)

The present investigation was undertaken with the goal of finding further examples of chemi-ionization reactions and to study their kinetics in detail. Two experimental facilities were used in the investigation of active hydrogen-NO reaction. The first of these is a Wood–Bonhoeffer-type flow system in which the active hydrogen is produced by a microwave discharge and allowed to react with NO. Ion concentrations were measured by an axially movable Langmuir probe. The observed ion current near the upstream end of the reaction zone was found to continuously increase with NO addition. Ion identification was made in a second facility in which an atomic diffusion flame is produced by allowing hydrogen from a microwave discharge to flow through a 10-mm-ID tube into the center of a 300-mm-ID Pyrex reaction chamber containing NO. The resulting characteristic pale red chemiluminescence zone was examined for ion content with a Bennett mass spectrometer. The only ions detectable, using either hydrogen or deuterium as the discharge gas, were those of NO^+. The energy or recombination of hydrogen (4.5 ev) is much smaller than the amount of energy required to ionize NO (9.2 ev). Therefore, it appears unlikely that a simple H-atom reaction produces the observed chemi-ions. I.v.L.

N64-18861 Humble Oil and Refining Co., Baytown, Tex.
REACTIONS OF IONS AND ELECTRONICALLY EXCITED SPECIES WITH ATOMS AND MOLECULES IN THE GAS PHASE
M. S. B. Munson and F. H. Field *In* Va. U. Project Squid 1 Apr. 1964 p 43–47 (See N64-18851 11-24)

This report deals with ion–molecule and chemi-ionization reactions in gases. The instrument employed is a mass spectrometer capable of operating at pressures up to about 1/2 mm Hg in the ionization chamber. The most noteworthy results of the complete study of methane–oxygen mixtures is the surprising lack of oxygenated products ions. The CH_4^+, CH_3^+, and CH_2^+ react slowly with O_2 relative to their reaction rate with methane. The C^+ and CH^+ react rapidly with O_2 to give CO^+ and CHO^+. The CH_4^+ reacts with O_2 to give CH_3^+ with a rate constant of 0.3×10^{-10} cc/molecule-sec and gives as the major oxygenated product, CH_3O^+, $k = 2.6 \times 10^{-11}$ cc/molecule-sec. The only observable product of O_2^+ with CH_4 was $CH_3O_2^+$, $k = 1.26 \pm 0.20 \times 10^{-11}$ cc/molecule-sec. This ion is presumably protonated formic acid, and the rate of the reaction is unexpectedly low. The studies of acetylene and oxygen are not complete, but data show the same low reactivity that was observed for methane–oxygen mixtures. There is no oxygenated product of relative concentration comparable to the secondary ions of acetylene, $C_4H_2^+$ and $C_4H_3^+$, which are formed primarily from reactions of $C_2H_2^+$. The CO^+, CHO^+, C_2HO^+, and $C_2H_2O^+$ are observed in small, though readily measurable, concentrations. No evidence for chemi-ionization reactions in these mixtures has been found. I.v.L.

N64-18892 Advanced Metals Research Corp., Somerville, Mass.
RESEARCH TO DETERMINE COMPOSITION OF DISPERSED PHASES IN REFRACTORY METAL ALLOYS. PART II: CONCENTRATION GRADIENTS IN REFRACTORY METAL BINARY DIFFUSION COUPLES Interim Report, 1 Jan. 1962-28 Feb. 1963
Robert E. Ogilvie, Sheldon H. Moll and Donald M. Koffman Wright-Patterson AFB, Ohio, AF Materials Lab., May 1963 106 p
(Contract AF 33(616)-7671)
(ASD-TDR-62-7, Pt. 2; AD-429221)

The concentration gradients present in pure metal and alloy incremental, two-component, diffusion couples were determined by means of electron-beam microanalysis. The binary systems studied included Cb-V, Cu-Pt, and Ta-Pt. In a parallel study the equilibrium chemistry of individual phases present in two-phase alloys of the Ta-Pt system was determined by means of electron-beam microanalysis. The crystal structures, lattice parameters and chemistries of dispersed phase precipitates in two Mo-TZC alloys (1.6 Ti-0.58 Zr-0.13C) were determined. One alloy was as-extruded and the other as-swaged. The combined techniques of X-ray diffraction and electron-beam microanalysis were employed. The phases were shown to be alloy carbides of the TiC and ZrC systems. Author

N64-18910 Ohio State U. Research Foundation, Columbus
THE MECHANISM OF OXIDE FORMATION IN THE INITIAL STAGES OF OXIDATION Final Report, 1 Jul. 1960-30 Jun. 1963
D. W. Rausch, K. L. Moazed, and M. G. Fontana 6 Mar. 1964 6 p
(Contract DA-33-019-ORD-3387)
(Rept. 13; AROD-2734:2; AD-436569)

The current program status includes the following: (1) A convenient experimental technique has been developed for studying metal–gaseous oxygen reactions at relatively high oxygen pressures in the ultrahigh vacuum of the field-emission microscope. This technique, which utilizes a Granville–Phillips valve, involves the production of a large negative-pressure gradient of oxygen extending away from the specimen, and features an unlimited supply of oxygen, relatively steady pressure, and radio response over the pressure range of 10^{-9} to 10^{-5} mm Hg. (2) An electron diffraction technique was developed for the identification of surface products on the shank of the emitter tip. (3) The kinetics and surface products of the reaction of gaseous oxygen on atomically clean tungsten and tantalum single-crystal substrates were found to be dependent upon the following factors: substrate temperature, substrate topography (crystallography and degree of imperfection), oxygen pressure and coverage, and contaminating gaseous species. (4) Nonsimultaneous nucleation at randomly spaced sites over the surface and relatively greater growth rates perpendicular to the surface than those lateral to it (needle-like growth) were observed in the oxidation of tantalum with oxygen in the presence of other gases, probably CO. I.v.L.

N64-18971 Joint Publications Research Service, Washington, D.C.
POLYMER CHEMISTRY IN COMMUNIST CHINA
21 Apr. 1964 103 p refs Transl. into ENGLISH of selected articles from Chung-kuo K'o-hsueh-yuan Kao-fen-tzu Hsueh-shu Hui-i Hui-k'an: 1961, (Peiping), 1963
(JPRS-24289; OTS-64-31121) OTS: $2.50

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N64-18988 Bureau of Mines, Albany, Ore.

SEPARATION AND DETERMINATION OF RARE EARTH METALS IN ZIRCONIUM-RARE EARTH ALLOYS

Edward Cogan 1964 11 p refs

(BMRI-6430)

Equilibrium phase diagram studies of zirconium–rare earth metal alloys prompted the development of a rapid gravimetric method for determining rare earths in zirconium in which the rare earths are absorbed from sulfuric acid solution of the alloy on a cation-exchange resin. The sample in 10-percent H_2SO_4 is introduced into the column, the zirconium is eluted with 10-percent H_2SO_4, and the rare earths are eluted with $(NH_4)_2SO_4$ solution and precipitated with NH_4OH. A tracer technique was employed to determine the efficiency of the procedure. Y_2O_3 and europium 154 and 152 (Oak Ridge) were added to 10 g of zirconium and taken through the entire procedure. Recovery averaged 97.6 percent on 0.002 μg europium in the rare earth fraction. Rare earths were determined in the range 0.10 to 90 percent. Author

N64-19003 Iowa State U. of Science and Tech., Ames Ames Lab.

SOLVENT EXTRACTION STUDY OF THE SYSTEM MONAZITE RATE EARTH NITRATES – NITRIC ACID – WATER – TRIBUTYL PHOSPHATE

Brooks Martin Sharp (Ph.D. Thesis) and Morton Smutz Nov. 1963 157 p refs

(Contract W-7405-ENG-82)

(IS-780) OTS: $2.75

Using single-stage equilibrium data for the following systems, plus the assumption of mutual immiscibility of water and tributyl phosphate (TBP), a calculation method was developed to give the conditions, by stage, in a cascade of equilibrium stages with all species present in the flow streams. The systems are:

(1) $La(NO_3)_3$—HNO_3—TBP—H_2O;
(2) $Pr(NO_3)_3$—HNO_3—TBP—H_2O;
(3) $Nd(NO_3)_3$—HNO_3—TBP—H_2O;
(4) $Sm(NO_3)_3$—HNO_3—TBP—H_2O;
(5) $La(NO_3)_3$—$Pr(NO_3)_3$—HNO_3—TBP—H_2O;
(6) $Nd(NO_3)_3$—$Pr(NO_3)_3$—HNO_3—TBP—H_2O; and
(7) $Sm(NO_3)_3$—$Pr(NO_3)_3$—HNO_3—TBP—H_2O.

The calculation method was checked via a series of simulated column experiments. The agreement between predicted and experimental conditions by stages was considered reasonable, and the calculation is considered useful for engineering work. Author

N64-19031* Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center

HEATS OF FORMATION AND THERMODYNAMICS OF ORGANIC DERIVATIVES OF THE LIGHTER ELEMENTS Quarterly Technical Summary Report No. 21, 1 Jan.-31 Mar. 1964

D. R. Douslin, N. K. Smith, J. F. Messerly, R. T. Moore and Ann Osborn Apr. 1964 5 p

(ARPA Order 416, Amend. 1)

Research on this project is directed toward heat-of-combustion and heat-of-vaporization measurements on selected compounds of significance to chemical propulsion. First results on the burning of dekazene indicate that satisfactory heat-of-combustion values will be obtained from combustions now in progress. Several experimental techniques preliminary to the burning of aluminum borohydride have been developed. Acquisition and purification of samples continue to be a major problem. Author

N64-19038 Hanford Atomic Products Operation, Richland, Wash.

QUANTITATIVE METALLOGRAPHY OF HYDRIDE PHASE IN ZIRCALOY-2 PROCESS TUBES

L. A. Hartcorn and R. E. Westerman Nov. 1963 21 p refs

(Contract AT(45-1)-1350)

(HW-74949) OTS: $0.50

Each Zircaloy-2 sample of a given hydrogen concentration was cut into three pieces to obtain micrographs of the transverse, longitudinal, and planar sections. Comparison of the hydrided samples shows that the three sections exhibit different hydride patterns at the same level. A magnification of 250X was suitable for revealing the hydrides while retaining a reasonable area to minimize sampling error. Though the individual samples were homogeneously hydrided macroscopically, some hydride segregation exists microscopically. A magnification of 500X more clearly defines the character of individual hydride particles. The micrographs contain large numbers of small black dots, which are probably second phase intermetallics of nickel, chromium, and iron. They are not associated with the hydride phase and must be ignored when visually estimating the hydride phase concentration. Author

N64-19043 European Atomic Energy Community, Brussels (Belgium)
DETERMINATION OF ALUMINUM IN SAP [DETERMINAZIONE DELL'ALLUMINIO NEL SAP]
W. Leyendecker and G. Serrini Joint Nuclear Res. Center, Ispra Establishment (Italy). Analytical and Inorganic Chemistry Service. Feb. 1964 15 p refs In ITALIAN, ENGLISH abstract (EUR-585.1) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86; 40 Belg. Fr.

A sufficiently rapid method for the quantitative determination of aluminum in SAP powders and sintered products is described. In both cases the standard deviation is ±0.25% for aluminum contents between 82% and 94% and for a sample of about 0.350 g. Possible interferences have been investigated. Author

N64-19094 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
PRINCIPLES OF RADIOCHEMISTRY
I.E. Starik Mar. 1964 521 p refs Transl. into ENGLISH of the book "Osnovy Radiokhimii" Moscow, Izd. AN SSSR, 1959 p 1-459
(AEC-TR-6314) OTS: $6.00

This book deals with the theoretical principles of radiochemistry and includes chapters on the following: (1) the state of microquantities of radioactive isotopes in liquid, gaseous, and solid phases; (2) the distribution of microquantities of radioactive isotopes in heterogeneous systems; (3) the adsorption of radioactive isotopes; and (4) the electrochemistry of radioactive substances. I.v.L.

N64-19098 California U., Berkeley Lawrence Radiation Lab.
THE KINETICS OF THE HIGH-TEMPERATURE HYDROLYSIS OF MAGNESIUM FLUORIDE
Donald R. Messier (Ph.D. Thesis) 30 Jan. 1964 47 p refs
(Contract W-7405-ENG-48)
(UCRL-11103) OTS: $1.00

Weight-loss measurements and microstructural evidence have indicated that the rate of hydrolysis of MgF_2 in the temperature range from 745° to 835° C is controlled by the rate of chemical reaction at the MgF_2–MgO interface. It was possible to interpret the mechanism in terms of three steps involving: (1) chemisorption of water vapor; (2) formation of an intermediate hydroxyfluoride complex; and (3) decomposition of the hydroxyfluoride complex to form products. The assumptions that the chemisorption step was in equilibrium, and that the HF pressure was negligible, allowed the reaction rate dependence upon water-vapor pressure to be expressed in terms of the Langmuir adsorption isotherm. Author

N64-19132 Picatinny Arsenal, Dover, N.J. Propellants Lab.
A THERMOCHEMICAL INVESTIGATION OF THE COMPLEX FORMED BY CYCLOTETRAMETHYLENETETRANITRAMINE-(HMX) AND DIMETHYLFORMAMIDE (DMF)
Charles Lenchitz and Rodolph Velicky Feb. 1964 29 p refs (Tech. Memo. 1343; AD-435690)

The heat of dissociation (ΔH_D) of the complex formed by cyclotetramethylenetetranitramine and dimethylformamide, HMX:DMF, was measured in DMF. ΔH_D for two reactions are reported: (1) HMX:DMF(s) $\xrightarrow{DMF(l)}$ α HMX(s) + DMF(l), 5.2 kcal/mole is absorbed. (2) HMX:DMF(s) $\xrightarrow{DMF(l)}$ β HMX + DMF(l), 4.6 kcal/mole is absorbed. The difference in crystal energy between α HMX and β HMX as measured in acetone is 0.6 kcal/mole. A mechanism for the solution of HMX in DMF is proposed. The energies measured suggest that the bond forming the complex is due to van der Waals forces. It is also suggested that the dipole–dipole interaction makes a significant contribution to the bond energy. Author

N64-19173* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS VI: REACTIONS OF ^1D OXYGEN ATOMS IN THE PHOTOLYSIS OF CARBON DIOXIDE
P. Warneck Mar. 1964 30 p refs
(NASA Contract NASw-840)
(NASA CR-53748; GCA-TR-64-7-N) OTS: $2.60 ph

The vacuum ultraviolet photolysis of CO_2 has been investigated in the pressure region 150 to 760 mm Hg. At 1,236 A and around 1,600 A, the quantum yields for carbon monoxide, oxygen, and ozone are consistent with the direct photodissociation mechanism, while an increase in the quantum yields at 1,470 A indicates that at this wavelength, excited CO_2 molecules are also involved in the critical step. From the low rates of ozone formation observed in all cases, it is concluded that the photodissociation of CO_2 produces oxygen atoms in the metastable ^1D state. Author

N64-19174* Aerojet-General Corp., Azusa, Calif. Von Karman Center
RESEARCH ON PROCESSES FOR UTILIZATION OF LUNAR RESOURCES [Quarterly Progress Report, 16 Nov. 1963-29 Feb. 1964]
S. D. Rosenberg, G. A. Guter, and G. R. Jameson Mar. 1964 29 p refs
(NASA Contract NAS7-225)
(NASA CR-53749; Rept. 0765-02-1) OTS: $2.60 ph

Laboratory apparatus has been designed, fabricated, and operated for studying the reaction of methane and natural silicates to yield hydrogen, carbon monoxide, and slag. Successful runs were performed with the equipment, under varying conditions, with the use of a 450-kc induction heater. Excellent temperature control was achieved up to the operating limits of the apparatus (1,900° C). Several runs are reported that relate to development of the unit. Silicates were reduced with methane to form carbon monoxide, hydrogen, and slag by bubbling the gas through the rock melt. Incomplete reaction of carbon with the silicates was noted. Author

N64-19191 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELECTROSYNTHESIS OF OZONE. VI. STEADY-STATE CONCENTRATIONS AND THE MECHANISM OF OZONE FORMATION
V. G. Samoylovich and Yu. V. Filippov 15 Jan. 1963 12 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 36, no. 7, 1962 p 1420–1425 refs
(FTD-TT-62-1536/1+2+4; AD-298235)

The steady-state ozone concentration in a circulating system is not a function of the active current in the ozonizer. At high pressures, it is also not a function of pressure. At reduced pressure, there is at first a smooth drop in ozone concentration, and then at comparatively low pressures the drop is sharp. A mechanism is proposed for the formation and decomposition of ozone that takes into account both bulk and surface processes. The latter play an especially large role in ozone synthesis at low pressures. Author

N64-19237 Oak Ridge National Lab., Tenn. Chemical Technology Div.
THE EFFECT OF NITRIC ACID, THORIUM, FLUORIDE, AND ALUMINUM ON PROTACTINIUM ADSORPTION BY UNFIRED VYCOR GLASS
J. G. Moore Apr. 1964 19 p refs
(Contract W-7405-ENG-26)
(ORNL-3599) OTS: $0.50

The amount of adsorbable protactinium and its distribution coefficient (DC = counts min^{-1} g of $glass^{-1}$/counts min^{-1} ml^{-1} solution) with 60 to 80 mesh unfired Vycor glass has been determined for Pa^{233} tracer solutions containing 4 to 100 g Th/liter, 0.5 to 12 M HNO_3, 0 to 0.04 M HF, and 0 to 0.4 M Al $(NO_3)_3$. The distribution coefficient (DC) from solutions containing only thorium and nitric acid may be calculated as follows: $DC = (378 \pm 72) + (384 \pm 9)x - (1.27 \pm 0.13)xy - (1.13 \pm 1.02)y$, where x = M HNO_3, and y = g Th/liter. In solutions containing 100 g Th/liter, the coefficient increased slightly with increasing fluoride when the solution was less than about 3.5 M HNO_3. At higher nitric acid concentrations, the coefficient decreased with increasing fluoride. The addition of aluminum partially canceled the effects of fluoride, but the maximum was still only half of thorium–nitric solution containing no fluoride or aluminum. Author

N64-19252 Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
MINIMUM SAMPLE SIZES FOR URANIUM CONCENTRATE SAMPLING Topical Report
S. D. Nelson, T. J. Kneip, and A. H. Mohl 30 Apr. 1964 18 p refs
(Contract W-14-108-ENG-8)
(MCW-1454) OTS: $0.50

A study has been made to determine the sample size necessary to reduce the theoretical sampling variance to an insignificant level in sampling well-blended uranium concentrates. This study, following a theory described by Benedetti–Pichler, resulted in sample sizes calculated as functions of the physical and chemical characteristics of the sampled materials and the sampling variance. The sampling variance values chosen were those that would be insignificant with respect to the analytical variance at the 95% confidence level. It was found that the present sampling procedure removes a sample that is larger than that required for well-blended materials. Author

N64-19265 Naval Research Lab., Washington, D.C.
THE RADIATION-INDUCED CHAIN REACTION BETWEEN NITROUS OXIDE AND HYDROGEN IN AQUEOUS SOLUTIONS
C. H. Cheek and J. W. Swinnerton *In its* Rept. of NRL Progr. Mar. 1964 p 1–3 refs (See N64-19264 11-01) OTS: $1.25

The radiation chemistry of solutions containing mixtures of nitrous oxide and hydrogen has been studied in alkaline solution. Nitrous oxide oxidizes hydrogen by a radiation-induced chain reaction that proceeds moderately in neutral solution and very efficiently in strongly alkaline solution. Oxygen inhibits the chain reaction in neutral solution, but has no effect in strongly alkaline solution. The lack of a dose-rate dependence is attributed to chain-terminating reactions with impurities, over radical–radical combination. The results account in part for an alternate interpretation of the sigmoid increase in $G(N_2)$ at high pH in irradiated nitrous oxide solutions. Author

N64-19271 Washington U., Seattle
Final Technical Report, Oct. 1960–Oct. 1962 [BICYCLIC SMALL COMPOUNDS AND THE CHEMISTRY OF CYCLOPROPENE AND ITS COMPOUNDS]
Kenneth B. Wiberg [1962] 7 p refs
(Contract DA-ORD-31-124-61-G41)
(AROD-2966-1; AD-426877) OTS: $1.10

A bicyclobutane derivative was synthesized via dehydrohalogenation of 3-bromocyclobutane-1-carboxylate with sodium triphenylmethide. Attempts were made to prepare a bicyclopentane derivative. Syntheses of bicyclohexane and bicycloheptane derivatives were achieved. Cyclopropene was prepared, and its properties were studied. It was shown to be a good dienophile, to have large strain energy, to form C_3H_3 upon electron impact, and to react readily with compounds such as iodine and diazoalkenes. The infrared, ultraviolet, and NMR spectra of cyclopropene were also studied. E.W.

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-18634 Texas U., Austin Electrical Engineering Research Lab.
STUDY OF VARIOUS RADIO PROPAGATION PROBLEMS AND OF THE PROPAGATION PARAMETERS INVOLVED THEREIN Final Report
Alfred H. La Grone 31 Jan. 1964 27 p refs
(Contract AF 19(604)-8038)
(Rept. 6-59; AFCRL-64-54; AD-435511)

A brief summary of research in the following areas is presented: (1) calculated values of absorption due to water vapor and oxygen in the millimeter spectrum; (2) power spectrum and correlation function evaluation of selected tower refractometer measurements; (3) frequency characteristics of radio propagation over a grove of trees in full leaf; (4) the use of 2 TM (tone modulation) cavity modes for dielectric distributions; (5) theoretical study of the bandwidth of radio propagation media; (6) a solution for ELF (extremely low frequency) propagation in the earth-ionosphere cavity bounded by an inhomogeneous anisotropic ionospheric medium; (7) an approximate solution of the radio field strength in the vicinity of a grove of trees; (8) high-altitude microvariations within the atmosphere's radio refractive-index profile; (9) considering forest vegetation as an imperfect dielectric slab; (10) antenna and radio wave propagation characteristics at VHF near and in the ground; (11) observations at and near vertical incidence with an M-33 radar; and (12) calculated refractive indices for small-amplitude geomagnetic disturbances. R.T.K.

N64-18636 Paris U. (France)
EXTRA LONG WAVES PROPAGATION WITH ROCKETS Final Report
E. J. Vassy 30 Dec. 1963 49 p refs
(Contract AF 61(052)-155; Contract AF 61(514)-1141)
(AFCRL-64-77; AD-434771)

Measurements of the field of a 16.8-kc transmitter at long distance (2,200 km) versus the height are presented. By day as well as by night, the field disappears at the height of 110 km. There is no modulation when the loop rotates with the rocket. The wave presents a dispersive effect depending on the earth's magnetic field. Author

N64-18695 General Dynamics/Astronautics, San Diego, Calif.
RESEARCH DIRECTED TOWARD THE INVESTIGATION OF SUITABILITY OF THE GLOTRAC TYPE G TRANSPONDER FOR USE IN THE RANGE CALIBRATION SATELLITE Final Engineering Report
R. Braun 1 Dec. 1963 164 p refs
(Contract AF 19(628)-3274)
(AFCRL-64-240(A); AD-433038)

The analytical investigations were subdivided into three studies: (1) heat dissipation and packaging study; (2) component and circuit study; and (3) radiation study. Each of these areas was examined with respect to the requirements peculiar to the Range Calibration Satellite (RCS) mission. It was found that a number of modifications are required in each area to assure that the transponder will operate reliably in the RCS environment over the required 6-month period. Detailed recommendations are listed. Author

N64-18786 Army Missile Command, Huntsville, Ala.
MILLIMETER TECHNIQUE EVALUATION OF GUIDANCE DATA ATTENUATION BY EXHAUST PLUMES
Augustus H. Green, Jr. 26 Mar. 1964 37 p refs
(RE-TR-63-31, Rev.; AD-426419)

The interaction of a plasma with an electromagnetic wave is related to three essential parameters: (1) the collision frequency of free electrons with neutral particles; (2) the free electron density; and (3) the frequency of the electromagnetic wave. The propagation constant is a function of the attenuation constant and the phase constant, which are related to the three parameters. An analysis of these parameters is essential to achieving an understanding of signal propagation through a plasma. By measuring the attenuation constant and the phase constant at selected frequencies, the collision frequency and the electron density may be determined. An analysis of these results indicates which types of propellants render good propagation characteristics. This report contains a development of the theory and the types of experiments that are planned or underway. The different problems that have been encountered are also discussed. Author

N64-18795 Stanford U., Calif. Systems Techniques Lab.
MICROWAVE PROPAGATION OVER MOUNTAIN-DIFFRACTION PATHS Final Report
A. Bruce Carlson Griffiss AFB, N.Y., RADC, Mar. 1964 135 p refs
(Contract AF 30(602)-2985)
(RADC-TDR-64-13; AD-435545)

A theoretical–experimental study of absolute diffraction at microwave frequencies has been conducted. The field strength in the geometric shadow zone can be predicted from classical (Fresnel–Kirchhoff) diffraction theory when the obstacle approximates the idealized knife edge. However, the modest amount of empirical knowledge available precludes an engineering evaluation of the obstacle-diffraction propagation mechanism from the viewpoint of microwave communications. Although the main concern was the total nature of the propagation, emphasis was given those factors that may affect the successful transmission of information. Author

N64-18876 Army Signal Research and Development Lab., Fort Monmouth, N.J.
SHORT-PULSE MODULATOR
Robert Combs Nov. 1963 13 p
(USAELRDL-TR-2414; AD-433702)

This program involves the construction of a 20-nanosecond modulator that will pulse a magnetron at a pulse repetition frequency of 15 kc with an input power of 20 kv at a 20 amp peak. The modulator is a hard-tube version that utilizes an E37B thyratron in the driver circuit to permit the use of high repetition rates. This, together with a length of RG8/U cable (as a pulse-forming network), develops a 20-nanosecond pulse width. The pulse is then amplified by the hard tubes and is capacitively coupled to the magnetron. Author

N64-18998 Texas A and M Research Foundation, College Station
ON THE EFFECTS OF ATMOSPHERIC REFRACTION ON RADAR GROUND PATTERNS
L. G. Cobb (M.S. Thesis) and V. E. Moyer 31 Dec. 1963 60 p refs
(NSF Grant 13834)
(Sci. Rept. 63-32T)

Photographs of the PPI of a 3.2-cm AN/CPS-9 radar are used to examine ground patterns. A normal pattern is determined and presented for comparison with nonnormal patterns, which are divided into groups according to size and location of anomalous echoes. Correlations are made between the echo patterns, their refractivity profiles, and the terrain. Anomalous ground-return echoes are related directly to topography, except when caused by elevated refracting layers. The amount of excess echo is proportional to the degree of superrefraction of the radar ray, which in turn is dependent on the gradient in and the thickness of the refracting layer. Author

N64-19075 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
W.D.C. C ROCKETS AND SATELLITES: LIST OF OPTICAL OBSERVATIONS OF SATELLITES MADE FROM U.K., EUROPE AND MALTA
Dec. 1963 22 p

The optical observations of satellites received by the Radio Research Station Prediction Service from observers in the United Kingdom, Malta, and Europe during December 1963, are presented. Information is included on the following: date, observing station, time, right ascension, declination, altitude, azimuth, and magnitude. R.T.K.

N64-19082 Pacific Missile Range, Point Mugu, Calif.
DETERMINATION OF ELEVATION AND SLANT RANGE ERRORS DUE TO ATMOSPHERIC REFRACTION
Colin Gardner [Dec. 1962[64 p refs
(Tech. Note 3280-6)

A direct derivation of the basic equations used to determine the effects of atmospheric refraction about a spherical earth is given. Direct integration of these equations gives simple formulas permitting the use of any type of refractive index profile. No restrictions have been made as to the size of the elevation angle, and computations can be made under trapping conditions with equal ease. The basic assumptions are: that Snell's law is valid for a spherical earth; the atmosphere can be adequately described by a series of constant gradient segments; and no restrictions shall be placed upon the thickness of the individual refractive index layer of constant gradient. Author

N64-19084 ACF Industries, Inc., Hyattsville, Md. Electro-Physics Labs.
NOMOGRAMS FOR OBTAINING THE ARRIVAL ANGLE AND BEARING OF RADIO WAVES FROM MEASUREMENTS OF PHASE DIFFERENCE BETWEEN THREE STATIONS ARRANGED IN AN EQUILATERAL TRIANGLE

M. Lindeman Phillips 23 Apr. 1963 13 p refs
(External Tech. Memo No. E15)

The nomographic procedures described were devised for facilitating computation of values for wave arrival angles obtained from a 3-station receiver system. Instructions are included for the construction and use of the nomograms. The particular 3-port configuration considered utilized three wideband, vertically polarized, monopole antennas placed at the apices of an equilateral triangle. R.T.K.

N64-19088 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
COORDINATES OF OBSERVERS, 1963: OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE
Jan. 1964 20 p

Data are given concerning the coordinates of satellites as determined by optical observations. The names of the particular observing stations are given along with the observing time, right ascension, declination, altitude, azimuths, and magnitude. C.L.W.

N64-19208 Florida U., Gainesville Engineering and Industrial Experiment Station
AN INVESTIGATION OF METHODS OF DETECTING AND CORRECTING ERRORS IN DATA TRANSMISSION SYSTEMS Final Report
W. W. Peterson, M. J. Moss, J. B. O'Neal, and E. J. Weldon Feb. 1964 30 p refs
(Contract AF 19(628)-431)
(AFCRL-64-121; AD-436587)

Important bounds on reliability with feedback, which give new insight into this problem, have been reported. Some progress on the fundamental problem of the implications of quantum theory in communication has also been made on this project. A number of computations have been made properties of Bose–Chaudhuri codes. Several theorems on coding have been found, and one potentially important property has been observed in many Bose–Chaudhuri codes, but it has not yet proved to be true in general. Slight progress on bit-loss-correcting codes is reported. Author

N64-19278 Dartmouth Coll., Hanover, N.H. Thayer School of Engineering
STUDIES OF WHISTLERS AND AUDIO-FREQUENCY EMISSIONS Final Report [1 Oct. 1961–31 Oct. 1962]
Millett G. Morgan 19 Aug. 1963 28 p refs
(Contract AF 19(604)-8468)
(AFCRL-63-773; AD-432829)

CONTENTS:

1. SOME RESULTS OF FIVE YEARS OF WHISTLER OBSERVATIONS FROM LABRADOR TO ANTARCTICA T. Laaspere, M. G. Morgan, and W. C. Johnson 16 p refs (See N64-19279 11-08)

N64-19279 Dartmouth Coll., Hanover, N.H. Thayer School of Engineering
SOME RESULTS OF FIVE YEARS OF WHISTLER OBSERVATIONS FROM LABRADOR TO ANTARCTICA
T. Laaspere, Millett G. Morgan, and W. C. Johnson *In its* Studies of Whistlers and Audio-Frequency Emissions 19 Aug. 1963 16 p Repr. from Proc. Inst. Elec., Electron. Engr., v. 51, no. 4, Apr. 1963 p 554–568 (See N64-19278 11-08)
(Sponsored by NSF and Natl. Acad. of Sci.)

This is a comprehensive presentation of the results of 5 years of synoptic whistler observations from Labrador to Antarctica. Conclusions were that the shape of diurnal curves is determined largely by conditions of whistler propagation rather than of generation. The curves presented will be useful in predicting the behavior of manmade signals propagating in the "whistler mode" through the ionosphere and the earth's magnetosphere. Diurnal variations in local seasons are diagrammed. A.W.

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 08 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-18565 Hazeltine Corp., Indianapolis, Ind. Electronics Div.
BINARY-TO-VIDEO DATA CONVERTER Final Report
Gerald E. Fenimore et al Griffiss AFB, N.Y., RADC, Feb. 1964 43 p
(Contract AF 30(602)-2856)
(Rept. 6146; RADC-TDR-63-427; AD-434759)

A study was made of various techniques for a binary-to-video converter suitable for accepting binary information from a computer (or similar type of input) and producing a display on a TV raster. Information to be shown on the display included alpha-numerics, symbols, map data, and similar processed-data readout in the form used for command and control displays. Since a television picture is already quantized by its horizontal line structure, a dot matrix character form is considered the most logical approach. Various techniques of dot character generation are described and compared. It is concluded that a data converter system capable of storing a digital representation of entire TV rasters would provide the most satisfactory solution. Where a number of different display pictures are to be assembled for simultaneous viewing by different persons at different local areas, a common system with a magnetic drum that provides multiple outputs is recommended. Author

N64-18609 Motorola Inc., Phoenix, Ariz. Integrated Electronics Research Dept.
MINIATURE THIN FILM INDUCTORS Third Interim Report, 1 Dec. 1963–1 Mar. 1964
F. R. Gleason 31 Mar. 1964 14 p
(Contract NObsr 85397)
(Rept. 4003-3; AD-434051)

The effect of ferrite material thickness on the inductance of an encapsulated coil was studied. It was determined that a 40-mil (1,000 micron) thick layer of material is required for maximum permeability effect. Spiral coils of increased air core inductance were fabricated. The 1.8 microhenry, 23-turn coil has not been completed because of evaporation mask alignment problems. Spiral coils of a gold–rhodium alloy were fabricated so that a deposited ferrite film encapsulating these coils can be annealed or sintered at elevated temperatures, i.e., greater than 1,050° C. The higher annealing temperature is required to obtain lower porosity and larger crystallites in the ferrite film for increased initial permeability. Some success in fabricating a coil that withstood 1,100° C has been achieved. Techniques were studied for fabricating two coils in a mutually aiding inductive geometry on a single substrate. The coils are separated by a ferrite film deposit. Author

N64-18651 Stanford U., Calif. Microwave Lab.
MULTIMEGAWATT BROADBAND MICROWAVE TUBES Second Annual Report, 1 Nov. 1962–31 Oct. 1963
Marvin Chodorow Griffiss AFB, N.Y., RADC, Mar. 1964 96 p refs
(Contract AF 30(602)-2575)
(RADC-TDR-64-58; ML-1116; AD-435550)

This report covers progress on eight tasks: (1) oscillation suppression in high power TWT's; (2) study of the centipede TWT structure; (3) improvement of stability of the long-slot TWT; (4) development of a nonperiodic dielectric-lined TWT; (5) development of extended-interaction klystrons; (6) study of hollow beam electron guns; (7) study of transverse-wave devices; and (8) investigation of electron-beam interaction with a plasma. Author

N64-18653 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
RESEARCH AND EXPERIMENTATION ON SPACE APPLICATIONS OF MILLIMETER WAVES Semiannual Technical Note, 1 Jan.–30 Jun. 1963
J. Stacey 5 Feb. 1964 260 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-294; TDR-169(3250-41)TN-2; AD-434543)

The Space Radio Systems Facility consists of a precise 15-ft antenna with its associated digital control and data processing equipment. A description of the instrumentation is given, and the initial observational plans are outlined. A technical description is given of the planning and fabrication of the precision large aperture antenna. The aperture is circular, and the configuration is Cassegrainian. Surface tolerance measurements indicate a prospective capability of efficient operation at wavelengths down to 1 mm (300 Gc) over the total 15-ft diameter. Author

N64-18740 Radio Corp. of America, Somerville, N.J. Semiconductor and Materials Div.
GALLIUM ARSENIDE VARACTOR DIODES Final Development Report, 27 Jun. 1962–27 Jun. 1963
H. Kressel, A. Solomon, G. Kupsky, and H. Lee 26 Aug. 1963 81 p refs
(Contract NObsr-87405)
(AD-435643) OTS: $8.10

Gallium arsenide varactor diodes designed for efficient conversion (40%) of power between 12 Gc and 24 Gc have been fabricated. These devices have breakdown voltages between 9 and 57 volts and cutoff frequencies at breakdown between 240 Gc and 396 Gc. A process for controlling the base width has proved to be an effective means of increasing the cutoff frequency of nonepitaxial diodes. Reasonable agreement is found to exist between calculated and observed values of cutoff frequency and thermal resistance as a function of breakdown for nonepitaxial devices. Calculations show that the use of epitaxial gallium arsenide films of controlled thickness and resistivity should result in devices with improved cutoff frequencies. Author

N64-18754 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DIAGRAM OF AUTOMATIC COMPENSATION OF DRIFT OF ZERO IN ELECTROMETRIC AMPLIFIERS AND ITS ANALYSIS
D. E. Polonnikov 19 Jul. 1963 13 p refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), v. 23, no. 12, 1962, p 1669–1674
(FTD-MT-63-47/1+2; AD-434967)

A circuit is proposed for automatic compensation of null drift in electrometer amplifiers that keeps a high input resistance and has a common grounding point for the amplifier input and output. The circuit operation is analyzed, and some recommendations on choice of optimum main parameters are given. Author

N64-18783 Electronic Communications, Inc., Timonium, Md. Research Div.
EXPERIMENTAL PROGRAM OF STEERABLE ANTENNA FOCUSING INVESTIGATION (STAFT): TWO-DIMENSIONAL SELF-FOCUSING ARRAY ANTENNA MODEL Technical Documentary Report No. 2, 1 May-31 Jul. 1963
Griffiss AFB, N.Y., RADC Nov. 1963 120 p refs
(Contract AF 30(602)-2930)
(RADC-TDR-63-418; AD-425400)

The field probing system was completed and put into operation. Initial trial runs were made to determine the characteristics of the equipment, and, as a result, several refinements were added to improve undesirable operation features. The first group of tests involved the collection of Fresnel zone radiation data for the square aperture array in programed and self-focusing modes of operation for a point focus. Patterns are included for mills cross and compact array arrangements, and for a two-dimensional Chebyshev amplitude taper. The effects of antenna element factor on the radiated field were measured by direct substitution of larger horn elements. Author

N64-18840 Catholic U. of America, Washington, D.C.
FERRIELECTRICS AND THEIR APPLICATION IN SOLID STATE DEVICES AS AN ADAPTIVE CONTROL
Charles F. Pulvari *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 228–246 refs (See N64-18826 11-16)

The basic properties of the recently discovered ferrielectrics, which are essentially degenerate antiferroelectrics exhibiting ferroelectric properties, are discussed. Capacitors having a ferrielectric dielectric possess a true switching threshold field similar to ferrites. A new device that operates similar to the transfluxor and represents an electrostatically controlled circuit impedance with stored settings is discussed. This device is called a transpolarizer. The most interesting feature of the transpolarizer is that, by the application of a control signal, it can be changed from a ferroelectric capacitor into a linear capacitor and can assume any intermediate polarization level between these two limits; furthermore, it is capable of controlling a flow of a.c. electric power according to its setting. Author

N64-18844 Texas Instruments Inc., Dallas Semiconductor-Components Div.
OPTOELECTRONIC FUNCTIONAL ELECTRONIC BLOCKS Second Interim Engineering Report, 1 Nov. 1963-31 Jan. 1964
J. R. Biard 27 Mar. 1964 61 p refs
(Contract AF 33(657)-11552)
(Rept. 03-64-20; AD-434170)

Investigations of optoelectronic phenomena are being performed in an effort to extend the applicability of integrated circuits. The program has been divided into two tasks: (1) the design and fabrication of an optoelectronic pulse amplifier and an optoelectronic d.c. amplifier, and (2) the development of semiconductor technology necessary to adequately implement the two optoelectronic functional electronic blocks selected for study. The technology investigations include studies of optical coupling structures, $GaAs–GaAs_{(x)}P_{(1-x)}$, slice processing, and junction passivation. Author

N64-18845 Microwave Associates, Inc., Burlington, Mass.
UHF DUPLEXERS Fifth Quarterly Progress Report, 5 Nov. 1963-5 Feb. 1964
Henry Griffin and Sumner Segal 1964 30 p
(Contract NObsr-89105)
(AD-436028)

A three-port ferrite circulator was developed that successfully demonstrated a power-handling capability of 500-kw peak power and 10-kw average power. The insertion loss is less than 0.5 db over the band 400 to 450 mc. For receiver protection after the ferrite circulator, a solid-state diode limiter was developed. The insertion loss of the limiter is less than 0.8 db over the 400- to 450-mc band. A power-handling capability of 150-kw peak and 0.5-kw average was demonstrated with a 60 μsec pulse width. A leakage power of 300-mw peak was obtained with no spike leakage. For the 200- to 225-mc band, a complete solid-state diode limiter has been achieved that can successfully switch 200-kw peak power, 2-kw average power, with a 200μs pulse width. A transmit loss of 0.1 db and a receive loss of 2.2 db were obtained with a leakage power of 13-mw peak to the receiver. Author

N64-18877 Emmanuel Coll., Boston, Mass. Research Language Center
THE DISINTEGRATION PITCH OF FUSE WIRES IN QUARTZ-SAND [PODZIALKA ROZPADU DRUTOW TOPIKOWYCH W PIASKU]
Jan Nasilowski Bedford, Mass., AFCRL, Oct. 1963 7 p ref
Transl. into ENGLISH from Przegl. Elektrotech. (Warsaw), v. 38, 1962 p 264–265
(Contract AF 19(604)-8505)
(E-T-P-63-2; AD-430980)

Sample inserts with a copper fuse wire in quartz-sand were examined. The dimensions of the grains were 0.2 to 0.4 mm. The relationship obtained from X-ray analyses between the average pitch of disintegration and the diameter of the wire, wherein $h_{\text{average disintegration}} = 0.555 + 2.08d$, negates the hypothesis of undulatory disintegration of the wire, since the undulation scale is determined by the formula $h_{\text{average undulation}} = 5.33d$. The relationship $h_{\text{average disintegration}}$ is defined as a simple six-point regression. Moreover, the large value obtained for the coefficient of regression, $r = 0.998$, indicates the existence of regression. The probability of the nonexistence of rectilinear regression of the variables h and d is less than 0.01. The pitch of segment disintegration also depends on the granulation of the quartz-sand. An increase in the granulation size above 0.2 to 0.4 mm causes an increase in the disintegration pitch. I.v.L.

N64-18885 General Electric Co., Holyoke, Mass.
HIGH POWER, HIGH VOLTAGE, AUDIO FREQUENCY TRANSFORMER DESIGN MANUAL Interim Development and Sixth Quarterly Report, 1 Oct.-31 Dec. 1963
1 Jan. 1964 637 p refs
(Contract NObsr-87721)
(AD-434354)

Progress was reported in the following areas: (1) mechanical design parameters and component selection for 105°, 130°, and 200° C hot spot transformer design; (2) design parameters for insulation and cooling for 200° C and calculation formulas for winding rise; (3) measurement of distributed capacitance; (4) electrostatic shielding; (5) procedure for calculating copper losses; and (6) a sample solution for determining the maximum effective area of cruciform cores. Author

N64-18914 Radio Corp. of America, Princeton, N.J.
THEORY OF ADJUSTABLE SWITCHING NETWORKS Special Scientific Report No. 3
S. Amarel, S. Y. Levy, C. V. Srinivasan, and R. O. Winder 30 Nov. 1963 124 p refs
(Contract AF 19(604)-8423)
(AFCRL-64-66; AD-435549)

The initial stages of work on the threshold-logic test synthesis problem are as follows: to determine, for given switching functions, whether or not they are threshold functions (test), and if they are, to obtain realizations (synthesis). Included is a discussion of the preliminaries of test-synthesis: checking of unateness and positivization; checking of 2-monotonicity, ordering of arguments, and writing of the canonical form; and derivation of the complement and the reduced representations. Also included is a discussion of the basic system of linear equalities for test-synthesis and their reduction. The study of the reliability of switching networks provides partial results on the various problems under investigation. A specific set of investigations on the following topics is presented: a comparison of an active scheme of self-correction with the passive majority scheme; economical procedures to detect errors in combinational nets; the design of reliable asynchronous control for logical nets; and the concept of sequential computation of combinational functions, its significance and potentialities. Author

N64-18919 General Dynamics/Fort Worth, Tex. Engineering Dept.
RESEARCH ON METAL INCLUSIONS IN RADOMES
H. E. Athey and C. L. Price, Jr. 15 Apr. 1964 43 p refs
(Contract AF 33(657)-11214)
(ERR-FW-050; AD-436337)

The use of metal in radomes offers two main advantages. Metal can be used for reinforcement, and use of metal can change the electrical characteristics of a sandwich type radome so that it can be made thicker physically and still be acceptable electrically. The data show that radomes can be made sensitive to polarization and that transmission efficiency can be improved through the use of metal grids for specific frequencies of operation. The data also reveal that the addition of metal grids can make radomes display waveguide characteristics rather than standard half-wave and quarter-wave panel characteristics, thereby providing improved electrical performance over broad frequency bands. Author

N64-18920 General Dynamics/Fort Worth, Tex. Engineering Dept.
RADOME IMPROVEMENT STUDIES
H. E. Athey and C. L. Price, Jr. 15 Apr. 1964 22 p ref
(Contract AF 33(657)-11214)
(ERR-FW-114; AD-436336)

Transmission efficiency measurements of a sandwich panel at various incidence angles were determined over a range of frequencies from 2 to 29.2 kilomegacycles. The sandwich panel contained a metallic grid embedded at the center of each skin thickness. Test results indicated that the gridded panel and dielectric filled waveguide possess similar band-pass characteristics. An investigation of antenna beamshift and side-lobe effect from the gridded sandwich panel showed negligible beamshift was introduced and side-lobes were reduced 1.2 to 2 db. Author

N64-18942 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
MUTUAL COHERENCE AND THE ARRAY THEOREM
Daniel J. Jacavanco Jan. 1964 18 p refs
(AFCRL-64-19; AD-435619)

The array theorem is investigated by considering mutual coherence. It is first treated under the conditions of monochromatic illumination followed by a development of a generalized array theorem using the mutual coherence function. The coherent and incoherent limits are imposed upon the radiation with the following results. In the incoherent limit, and under the restriction of uniformly illuminated in-phase antennas, the array theorem gives the mutual intensity in the field. In the coherent limit, the array theorem generally holds, but in the partially coherent case, no separable form for $\Gamma_{12}(\tau)$ was available. Author

N64-19052 Army Missile Command, Huntsville, Ala. Electromagnetics Lab.
LABORATORY EVALUATION OF AN ELECTRONICALLY TUNED MICROWAVE FILTER
William M. Pless 31 May 1963 43 p refs
(RE-TR-63-26; AD-426414)

A laboratory evaluation is made of an electronically tuned microwave filter that utilizes a sphere of yttrium iron garnet as the tunable resonant circuit. The device acts as a passive bandpass filter for signals below a certain level of input power called the limiting threshold. For signals having powers greater than the limiting threshold, the filter acts as a power limiter. The evaluation consisted of measuring the dynamic range of the filter, determining its tuning curve and response characteristics, and observing and measuring the effects produced by the filter when a large signal (above the limiting threshold) and a small signal (below the limiting threshold) are simultaneously present in the bandpass of the filter. Author

N64-19055 Norwegian Defence Research Establishment, Kjeller
NON-LINEAR OSCILLATIONS IN TUNNEL DIODES Technical Note No. 8
L. O. Svaasand 16 Apr. 1963 27 p refs
(Contract AF 61(052)-484)
(AFCRL-64-21; AD-430775)

The high-frequency operation of a tunnel diode oscillator has been studied through approximative analytical solutions of the characteristic nonlinear differential equation of the oscillator. Special attention has been given to the case of quasi-harmonic oscillations. Certain characteristic phenomena of nonlinear resistance oscillators, such as amplitude quenching and hard oscillations, are shown to exist. Author

N64-19064 Microwave Associates, Inc., Burlington Mass.
MAGNETICALLY CONTROLLED GAS DUPLEXER Third Quarterly Progress Report, 27 Aug. 1963-27 Nov. 1963
Charles Ward Griffiss AFB, N.Y., RADC, Mar. 1964 29 p refs
(Contract AF 30(602)-2960)
(RADC-TDR-64-73; AD-436346)

Measurements of discharge-arc loss and leakage loss at S-band in a transverse magnetic field are discussed for the noble gases—helium, neon, argon, and 1% argon–99% neon Penning mixture. Pressures investigated range from 72μ to 25 mm. Magnetic-field recovery-time theory analysis in the low-pressure limit has demonstrated that resonant peaks in the afterglow can be used to indicate electron density. Author

N64-19068 Hughes Aircraft Co., Newport Beach, Calif. Semiconductor Div.
THE THIN-FILM TRANSISTOR (TFT) AS A CIRCUIT ELEMENT
H. G. Dill and R. Zuleeg 9 Dec. 1963 57 p refs
(DL63-26)

This paper considers the linear and nonlinear circuit application of the insulated gate field effect transistor operating in the enhancement mode. The operating mechanism of the TFT is briefly discussed and is related to temperature and ambient effects on parameters that determine the stability of the device. Results obtained with cadmium sulfide (CdS) films outline the present status of the TFT and emphasize certain future directions for research and development. Circuitry performance of the TFT in special circuits, not possible with other known transistor types, is demonstrated and supported by laboratory measurements. Author

N64-19071 Radio Corp. of America, Lancaster, Pa. Industrial Tube and Semiconductor Div.
DESIGN, DEVELOP, AND EVALUATE A HIGH-POWER INTEGRAL CIRCUITED TETRODE FOR 215 MEGACYCLE OPERATION Final Technical Report
I. E. Martin and A. W. Bachman 3 Dec. 1963 29 p
(Contract NObsr 85371)
(AD-426012)

The program encompassed the design, development, and evaluation of a high-power integral circuited tetrode (A-2696A), to meet the objectives of achieving 825 kilowatts peak-power output over a 10% frequency band, of delivering one tube of stable design, and three tubes of the final design with satisfactory shock and vibration characteristics. Author

N64-19109 Bell Telephone Labs., Inc., Whippany, N.J.
ENGINEERING SERVICES ON TRANSISTORS Report No. 13, 1 Jul. 1963-30 Sep. 1963
S. R. Arnold, D. J. D'Stefan, D. F. Foxhall, J. E. Iwersen, J. Kocsis et al 30 Dec. 1963 78 p refs
(Contract DA-36-039-SC-90759; Contract DA-36-039-AMC-02227(E))
(AD-432212)

Discussed is work on a 1-Gc, 1-w germanium transistor and a 6-Gc low-power germanium transistor and integrated circuit devices. Techniques and problems related to the oxide-photoengraved planar-transistor-structure fabrication are covered. A new method of determining emitter depletion-layer capacitance is described, and experimental results are given. Results of a calculation of effective mobility and diffusion coefficient for electrons and holes in germanium are given to permit more accurate estimates of base transit time and base resistance of high-frequency transistors. The integration of a small part of a high-speed general purpose military computer is described. The DCTL was used and 4- to 5-nanosecond propagation delay was obtained. Author

N64-19117 Harry Diamond Labs., Washington, D.C.
TEMPERATURE COMPENSATION OF ASTABLE MULTIVIBRATORS
Ira B. Marcus and Alan D. Smith 20 Jan. 1964 35 p
(TR-1186; AD-432255)

A study was made to determine the limits to which the frequency of astable multivibrators could be stabilized against temperature and power-supply voltage variations so that they could be used as a time base in electric time fuzes and programers. The temperature range was −55° to +75° C, and the voltage variation was ±20 percent. The frequency was about 100 cps. Four different circuits were developed. One circuit yielded ±0.06 percent frequency stability over the temperature and voltage range. Author

N64-19118 Eitel-McCullough, Inc., San Carlos, Calif.
HIGH POWER X-BAND GENERATOR Quarterly Report No. 3, 1 Apr.–30 Jun. 1963
William R. Luebke, Jared Leidigh, Siegfried Vogel, and Tore Wessel-Berg 26 Jul. 1963 54 p
(Contract AF 30(602)-2756)
(RADC-TDR-63-361; AD-433704)

The objective of this program is to develop a klystron amplifier operating at 8 kmc and delivering 1 mw of CW power. Assembly and testing of the high-power beam testers are described. Test results more than met the first phase goals of the program. A pulsed RF vehicle for evaluation of extended-interaction output cavities is nearly complete. A portion of a theoretical analysis of extended-interaction structures is given. Author

N64-19119 Motorola, Inc., Phoenix, Ariz.
COMPATIBLE TECHNIQUES FOR INTEGRATED CIRCUITRY Tenth Quarterly Report, 1 Aug.–31 Oct. 1963
[1963] 113 p
(Contract AF 33(616)-8276)
(AD-432222)

Efforts were concentrated in two areas: (1) the fabrication of units by the application of processes already under control, which includes fabrication of the IF and RF monolithic stages for the transreceiver, and fabrication of the differential amplifier and the modified AD ladder network for the DCS program; and (2) the extension of the state-of-the-art in the following areas: (a) the PNP/NPN technology; (b) the KMER etching mask; (c) selective gold diffusion; (d) SiO_2 capacitors; (e) process control work; and (f) the improvement of the stability of Nichrome resistors during flat-pack sealing. Also, all of the MECL units for the final DCS equipment are now available in flat packs and have been delivered to the quality control section for testing. I.v.L.

N64-19144 Montana State Coll., Bozeman Electronics Research Lab.
A FORMAL THEORY OF GENERALIZED MULTIPLE-OUTPUT BINARY COMBINATIONAL SWITCHING NETWORKS Final Report
William L. Kilmer Dec. 1963 16 p refs
(Contract AF 19(604)-6619)
(AFCRL-64-7; AD-434734)

This is a summary of the research and the resulting conclusions on multiple-output binary combinational-switching networks in narrative and tabular forms. Items discussed include steady-state memory, transients, cycling, and separability behavior of one-dimensional, combinational-cell iterative networks with unit-switching delays. G.D.B.

N64-19186 Eitel-McCullough, Inc., San Carlos, Calif.
HIGH POWER X-BAND GENERATOR Quarterly Report No. 4, Jul. 1, 1963–Sep. 30, 1963
William R. Luebke, Jared Leidigh, and Tore Wessel-Berg 18 Nov. 1963 60 p
(Contract AF 30(602)-2756)
(RADC-TDR-63-524; AD-436250)

The purpose of this program is to develop a klystron amplifier operating at 8 kmc and delivering 1 mw of CW power. A low-average power-pulsed tube having an extended-interaction output cavity is described, and test results are presented. Additional experimental work on the output circuit is discussed, and some design considerations for extended-interaction buncher cavities are included. Further test results of the megawatt-level d.c.-beam tester diode are outlined. On the basis of experimental work already performed, the design of high-average power, interim-development tubes has been carried out and is discussed. Additional theoretical material on the characteristics of extended-interaction structures is given. Author

N64-19194 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COMPENSATED COMMUTATING MECHANICAL RECTIFIERS
A. Ye. Kaplyanskiy and P. I. Petrov 12 Mar. 1963 15 p refs
Transl. into ENGLISH from Elektrichestvo (Moscow), no. 3, 1958 p 52–56
(FTD-TT-63-34/1+2+4; AD-299662)

Two compensated commutating mechanical rectifiers, each consisting of a transformer, a "brush-ring" system, a generator of compensatory emf's, and a "commutator-brush" system, are described and discussed. Both types of compensated commutating rectifiers are technologically similar to ordinary electrical machines and can be made at any electrical equipment manufacturing plant. It is suggested that such rectifiers would find application in areas needing small capacities (of the order of several tens of kilowatts) and low rectified voltages. P.V.E.

N64-19207 Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronic Systems Div.
MULTIPLE BEAM INTERVAL SCANNER Final Report
Francis J. La Russa 23 Mar. 1964 52 p refs
(Contract AF 19(604)-7385)
(AFCRL-64-192(II); F485-1; AD-437277)

A technique that solves the problem of maintaining a high data rate for large reflector-type antennas has been the subject of the MUBIS research program. In the MUBIS technique, a number of separate beams are generated and independently scanned, using a single line source fed by a wide-angle two-dimensional constrained lens. Possible antenna configurations using the MUBIS lens technique are discussed. Other topics discussed include: (1) the constrained lens; (2) possible areas of development—phase shifters in combination with organ-pipe scanners, and variation in interelement spacing; (3) possible uses of MUBIS in a three-dimensional radar system; (4) single-lens systems; (5) frequency-scanning possibilities of MUBIS; (6) the beam-switching concept—the Butler system, and the Maxson system; (7) phase-switching concept; (8) dual-lens systems—amplitude-sensing monopulse system, and phase-sensing monopulse system; (9) dual terminal antennas; and (10) multiple-lens systems. R.T.K.

N64-19234 Sperry Gyroscope Co., Great Neck, N.Y. Radiation Div.
CIRCUITED AMPLIFIER DEVELOPMENT
Griffiss AFB, N.Y., RADC, Mar. 1964 21 p
(Contract AF 30(602)-3102)
(RADC-TDR-64-87; EB-5296-0419; AD-437299)

The development of an inexpensive circuited amplifier chain is being investigated. The chain is to be capable of peak power outputs of up to 100 kw at UHF (432 mc) with broadband (40-mc) capabilities. Flatplate and stripline cavity construction, and new techniques in fabricating inexpensive d.c. blocks and bypass capacitors were investigated. Tube types were evaluated for life and performance vs. cost tradeoffs. Ease of maintenance, coupled with high component and amplifier reliability, was a major point of consideration. All unique features and technical advances were oriented to be compatible with mass production techniques providing phased-array cavity hardware at minimum cost. Author

N64-19260 Computer Control Co., Inc., Framingham, Mass.
INSTRUCTION MANUAL, MAGNETIC CORE MEMORY SYSTEM TCM-32 4096/25
Dec. 1963 129 p
(Rept. 71-170)

The manual covers system description and layout, installation, principles of operation, maintenance, a PAC complement list, and descriptions of the special S-PACS used in the system.
R.L.K.

N64-19270 New York U., N.Y.
RESEARCH IN THERMOELECTRIC MATERIALS Final Report [22 Dec. 1961-30 Jun. 1963]
A. Machonis, E. Pan, and I. Cadoff Aug. 1963 40 p refs
(Contract NObs-86364)
(AD-430561) OTS: $3.60

The electronic properties of single crystals of alloys of PbTe and SnTe in various ratios between the two limits are being studied. PbTe and SnTe are isomorphous and form a continuous series of solid solutions. The carrier sign of PbTe can be changed from n type for excess Pb to p type for excess Te. SnTe is p type and extrinsic for all stoichiometric ratios. When more than 15% SnTe is alloyed with PbTe the alloys become p type. The average carrier concentration as determined from Hall effect in general increased with increasing SnTe and was also found to be sensitive to changes in the composition range of stability of the compound (retrograde solubility etc.). An investigation of the compound Ba_2Pb, a relatively high mean atomic weight compound, was also started.
Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-18543 Martin Co., Denver, Colo. Aerospace Div.
A PRACTICAL METHOD OF PREDICTING THE ACOUSTICAL DYNAMIC ENVIRONMENT FOR LARGE BOOSTER LAUNCH FACILITIES
R.W. Peverley and E. B. Smith *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 89-101 refs (See N64-18534 11-33)

A review of prediction methods and their applicability to large booster systems is presented. The power spectrum, propagation constants, source location, and directivity are calculated for Titan and Saturn, and the results are compared to measured data. In addition, it is shown how this method was used to calculate Titan III and Saturn V launcher environments.
Author

N64-18554 David Taylor Model Basin, Washington, D.C.
MODEL BASIN PROCEDURE FOR THE ANALYSIS AND PRESENTATION OF VIBRATION DATA
E. Buchmann and R. G. Tuckerman *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 243-258 refs (See N64-18534 11-33)

Procedures used at the David Taylor Model Basin to analyze and present vibration data obtained from trials of surface ships and submarines are discussed. These procedures were developed to assist engineers in understanding the vibration phenomena on ships and to meet the objectives that prompted the vibration surveys. Samples of presentations include power and amplitude spectra, statistical distribution histograms, transient analysis of impulse loadings, mode shapes, and damping values.
Author

N64-18594 Parametrics, Inc., Waltham, Mass.
RESEARCH DIRECTED TOWARD THEORETICAL AND EXPERIMENTAL INVESTIGATIONS IN LABORATORY ASTROPHYSICS INVOLVING SHOCK HEATED HIGH TEMPERATURE GASES Final Report
Edmund H. Carnevale, Glenn S. Larson, and Stanley J. Wolnik 14 Feb. 1964 34 p refs
(Contract AF 19(628)-2428)
(AFCRL-64-154; AD-434357)

This report describes the design, construction, and development of a shock-tube facility. The spectroscopic, ultrasonic, and electronic equipment associated with the shock tube is also described. Simultaneous time-resolved photographic and photoelectric records of reflected-shock spectra are illustrated. Gas-temperature measurement by an ultrasonic-pulse method is discussed in addition to a proposed electron-beam technique for gas-density measurements.
Author

N64-18595 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
THE EFFECT OF VARIATIONS IN MOTION FIDELITY DURING TRAINING ON SIMULATED LOW-ALTITUDE FLIGHT Technical Documentary Report, Mar. 1961-Apr. 1962
Robert Buckhout (Aerospace Med. Res. Labs.), Howard Sherman, C. Thomas Goldsmith, and Patrick A. Vitale Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs. (6570th), Dec. 1963 128 p refs
(Contract AF 33(616)-8029)
(AMRL-TDR-63-108; AD-435543)

Two experiments testing the effects of variations in the fidelity of simulated motion during training on performance in a simulated low-altitude, high-speed mission were performed. The simulated mission required subjects to perform a one-dimensional (vertical) compensatory tracking task, while experiencing moderately heavy clear-air turbulence. The research led to the following conclusions: (1) Providing simulated motion during the learning of tracking skills contributes to more effective performance in criterion situations in which motion cues play an important role. (2) Performance on a procedural task (reaction time measures) during criterion testing did not differ significantly as a function of the type of training received.
Author

N64-18646 ARO, Inc., Arnold Air Force Station, Tenn.
SUPPLEMENTAL AERODYNAMIC CALIBRATION RESULTS FOR THE AEDC-PWT 16-FT SUPERSONIC TUNNEL
J. H. Nichols Arnold Eng. Develop. Center, Apr. 1964 44 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-76; AD-435732)

Recent surveys covered a 10-ft length of test section immediately downstream of the previously surveyed region. These surveys were obtained with an 8-ft traversing rake utilizing pitot-wedge, pitot, and cone probes. The data obtained from these surveys included the nozzle pressure recovery and the Mach number and flow misalignment distributions

on, and east and west of, the tunnel centerline. Correlations of average centerline Mach number and pressure recovery with corresponding measurements obtained with a retractable pitot-wedge probe were obtained at nozzle contour numbers from 2.25 to 3.00. Author

N64-18696 Public Health Service, Cincinnati, Ohio Occupational Health Res. and Training Facility
EVALUATION OF THERMAL ENVIRONMENT IN SHELTERS Final Report
Douglas H. K. Lee and Austin Henschel Aug. 1963 114 p refs
(Contract OCD-OS-62-100)
(TR-8; AD-428120)

Various schemes that have been advanced for expressing the significance of a given set of environmental conditions as a single number or as a semiquantitative simple phrase are reviewed, including the katathermometer, wet bulb-globe thermometer, effective temperature, operative temperature, EP index, P_4SR index, heat-stress index, and psychrometric plots. An index of relative strain is developed, similar to that used by Belding and Hatch in their heat-stress index, but based on Burton's wet-clothes formula for the calculation of actual and relative cooling demands. A chart is developed in which relative strain lines are drawn on a psychrometric chart for standard conditions of activity, clothing, air movement, and radiant heat transfer most likely to be found in shelters. A table is provided for adjusting the reading on the chart for certain nonstandard conditions of activity and air movement. Author

N64-18938 Minnesota U., Minneapolis
DESIGN AND INSTRUMENTATION OF A WATER FLOW CHANNEL AND APPLICATION TO SOME AERODYNAMIC PROBLEMS
Shukry K. Ibrahim Wright-Patterson AFB, Ohio, Res. and Tech. Div., Mar. 1964 54 p refs
(Contract AF 33(616)-8310)
(RTD-TDR-63-4024; AD-435738)

A water-flow channel was built to complement an existing water tow channel for investigating, by analogy, certain problems of aerodynamic deceleration in the subsonic, transonic, and low supersonic regimes. After a brief summary of earlier work, the mathematical basis of the analogy is presented. Some significant design characteristics and construction features of the facility are described, and details of the instrumentation are given. There follows an outline of the experimental and data-reduction procedures illustrated by typical experimental results, including some schlieren and shadowgraph pictures and numerical results of simulated pressure distribution tests. Author

N64-18951* Serendipity Associates, Sherman Oaks, Calif.
A STUDY OF PILOT ACCEPTANCE FACTORS IN THE DEVELOPMENT OF ALL-WEATHER LANDING SYSTEMS
Harold E. Price, Ewart E. Smith, and Walter B. Gartner Washington, NASA, Apr. 1964 181 p refs
(NASA Contract NAS2-1346)
(NASA CR-34) OTS: $3.00

The broad objective of the program is to identify principles that can be generalized and criteria for incorporating human user–operator acceptance data into decision-making activities that are directed toward the optimum allocation of functions in man–machine systems. Work was directed toward a delineation of all-weather landing system (ALS) functions and a review of light-control-function allocation in ALS's that have been proposed and/or are now under development. Author

N64-19020 Boeing Co., Renton, Wash. Airplane Div.
STATE-OF-THE-ART SURVEY FOR MINIMUM APPROACH, LANDING, AND TAKEOFF INTERVALS AS DICTATED BY WAKES, VORTICES, AND WEATHER PHENOMENA, PHASE I Final Report
W. J. Bennett Jan. 1964 67 p refs
(Contract FA-WA-4450)
(RD-64-4)

This report is a study of the generation and decay of the wake behind an aircraft, both the free air and ground effect, and its effect on following aircraft. An analysis is presented for both fixed- and rotary-wing aircraft, which defines the wake movement with time and the wake-induced velocities. The wake due to the propulsion system is analyzed both for normal operation and reversed thrust, as well as for pure propulsion lift. The influence of atmospheric parameters, such as wind, temperature, and turbulence is discussed as it applies to the generation and decay of the wake. Author

N64-19033 Federal Aviation Agency, Atlantic City, N.J. Systems Research and Development Service
EVALUATION OF LIGHTED CROSSBARS AND LIGHTED RUNWAY DISTANCE MARKERS Final Report
F. J. Meehan Feb. 1964 39 p
(RD-64-27)

Lighted crossbars extending across the width of the runway spaced at 1000-foot intervals, and internally lighted frangible distance markers adjacent to the runway also spaced at 1000-foot intervals, were evaluated to determine a suitable system for providing runway distance-to-go information during takeoff and landing operations. Painted numerals were also appraised. Flight testing was conducted in unlimited and restricted visibility conditions. It was determined that crossbars alone did not provide adequate distance-to-go information. Distance markers were not as effective as painted numerals under the lower visibility conditions. Crossbars when added to distance markers did not substantially improve the information obtained. High wind and engine blast effects caused marker damage. Numerals painted on the runway surface and located near the runway centerline were more effective than lighted runway-distance markers under the lower visibility conditions. Author

N64-19047 Kitt Peak National Observatory, Tucson, Ariz.
Monthly Report, February 1964 [ACTIVITIES OF THE STELLAR, SOLAR, AND SPACE DIVISIONS AND PROGRESS ON THE CERRO TOLOLO INTER-AMERICAN OBSERVATORY]
[1964] 17 p
(Supported by NSF)

Reports from the Stellar Division, Solar Division, and Space Division of the Kitt Peak National Observatory are presented. A detailed description of the building of the Tololo Road in Chile is given. Discussed are: water development at Los Placeres, construction at La Serena, expansion of the facilities of the University of Chile in La Serena, Tololo weather, mapping of Cerro Tololo and Cerro Morado, and observation programs. R.T.K.

N64-19087 System Development Corp., Santa Monica, Calif.
SIMULATION METHODS AND MODEL DESIGN
James R. Crawford 19 Jun. 1963 110 p refs
(TM-765/000/00)

The following are discussed: (1) outlining the simulation model—a sequence of approach to the detailed description of a system, (2) symbolic flow diagram, (3) the systematic evaluation of data, (4) the verification of action—the confined input method, and the task audit method, (5) the examination of response—variance and feedback, (6) simulation symbolism, and (7) model design. R.T.K.

N64-19095 Systems Analysis and Research Corp., Boston, Mass.
BENEFIT COST ANALYSIS OF AIRPORT SNOW, ICE, AND SLUSH REMOVAL Final Report
John W. Drake and Robert L. Schein Mar. 1964 159 p refs
(Contract FA-WA-4685)
(RD-64-28)

This analysis deals with the economic impact of snow, ice, and slush removal operations at eight U.S. airports including: Buffalo, New York; O'Hare International Airport, Chicago, Ill., Hopkins Airport, Cleveland, Ohio; Stapleton Field, Denver, Colorado; Wold-Chamberlain Airport, Minneapolis; John F. Kennedy International Airport, New York; Greater Pittsburgh Airport, Pittsburgh, Pennsylvania; and National Airport, Washington, D.C. The research approach included the conducting of both on-site interviews and operational simulation. Estimates were made of the costs incurred by both airport operators and users as a result of clearing operations during the winter of 1962–1963 and as forecast for a future time period around 1975. Author

N64-19111 Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Lab.
DEVELOPMENT OF AN ALTERNATING CURRENT PLASMA ACCELERATOR FOR APPLICATION AS AN ULTRA HIGH VELOCITY WIND TUNNEL Technical Documentary Report, 1 Jul. 1961-30 Jun. 1963
G. Fonda-Bonardi, A. Penfold, J. M. Rocard, and D. Curtis Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Dec. 1963 68 p refs
(Contract AF 33(616)-8458)
(ASD-TDR-63-834; AD-433248)

An electrodeless plasma accelerator for use in simulating reentry environments is described. Principles of its operation and a technical description of its several parts are given. Descriptions in detail are given of the gas injector, preionizer, magnetic structure, and cooling devices. The theory of accelerator operation necessary to a general understanding of the machine is included. Author

N64-19128 Radio Corp. of America, Burlington, Mass.
DESIGN OF AUXILIARY AIRFIELD CONTROL CENTRAL Final Report
J. J. Lauginiger, E. Le Blanc and D. Weise Bedford, Mass., Electron. Sys. Div., Dec. 1963 329 p refs
(Contract AF 19(628)-2964)
(ESD-TDR-64-185; AD-436851)

This report specifies in both quantitative and qualitative terms the technical parameters, characteristics, and performance of a new lightweight, air-transportable radar-control central design capable of exerting final approach control at auxiliary airfields. It includes, in detail, the basic requirements and operational parameters of an airport surveillance radar set, a radar beacon interrogator set, a precision approach radar set, radar display indicators, radio and telephone communications configuration, air conditioning and power requirements, and weather reporting facilities, along with their respective space and housing requirements. Also included are sample calculations, tables and graphs relative to radar range, performance, and specifications. Author

N64-19166 Bendix Corp., Teterboro, N.J. Eclipse-Pioneer Div.
A STUDY OF THE EFFECTS ON LATERAL AUTOMATIC LANDING PERFORMANCE OF OVERFLIGHT INTERFERENCE WITH THE WAVEGUIDE DIRECTIONAL LOCALIZER, PHASE II Final Report
J. Doniger 15 Apr. 1963 62 p refs
(Contract FAA/BRD-451)

Results are based on analog-computer simulations of various aircraft and control system combinations, and on the use of overflight interference data supplied by the Federal Aviation Agency. If the total interference duration is less than 40 seconds, there is no objectionable effect on landing aircraft of the DC-7 or KC-135 type. Interfering aircraft flying at less than 200 fps should be restricted to altitudes above 3,000 ft when flying over the runway and within the $\pm 8°$ sector defined by the standard directional localizer. For the TF102 type, the peak CDI deviations due to overflight interference should be less than $\pm 30\ \mu a$. This is possible if the interfering aircraft is above 8,000 ft and when the localizer transmitter is mounted 1/2 wavelength above ground. The overflight altitude restriction is proportionally reduced to 3,000 ft as the transmitter mounting height is increased to 3/2 wavelength. These restrictions only apply between the time that the landing aircraft is below 100 ft on its final approach and the time it leaves the active runway. Author

N64-19167 Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
STUDY OF CAPTURE-EFFECT GLIDE-SLOPE MONITOR TECHNIQUES Final Report
Oct. 1963 43 p
(Contract FA-WA-4385)
(RD-64-17)

The capture-effect glide-slope system is explained by comparison with a standard null-reference system, and the advantages of the glide-slope system are analyzed. An analysis of capture-effect monitor problems is presented. Solutions for the particular capture-effect monitor problems are presented and logically justified. A solution for the on-course monitor is recommended, as well as a solution for the course-width monitor-detector. An alternative solution for the course-width monitor is also presented. Analyses are given for the monitor effects of changes in amplitude and phase of the signals in the capture-effect glide-slope circuits, and of changes in coefficient of reflection and depth of snow in the monitor region. Operating a course-width monitor system that does not deteriorate because of the accumulation of snow near the glide-slope station is feasible. Author

N64-19289 National Aeronautical Lab., Bangalore (India)
OPTIMISATION OF TIN CAN THERMAL BALLAST REQUIREMENTS FOR BLOWDOWN WIND TUNNELS
B. N. Narahari Achar Nov. 1963 23 p refs
(TN-AE-21-63)

This note presents the results of an investigation undertaken to obtain engineering data regarding the economical use of tin cans as thermal ballast in the air receivers of blowdown wind tunnels. A simple analysis shows that a loading ratio of 2 to 3 would be sufficient to limit the temperature drop to about 20° C. Using tin cans of several sizes to find out the relative importance of dimensional parameters such as diameter and cylinder

length, an attempt has been made to determine the average surface area per cubic foot of space occupied by randomly stacked tin cans, since the available surface area is very important for effective heat transfer. The possibility of effecting a compromise between cost and thermal ballast efficiency in optimizing the dimensions of tin cans for a given weight of the ballast is indicated. Author

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-18582 California Inst. of Tech., Pasadena Karman Lab. of Fluid Mechanics and Jet Propulsion

AN EXPERIMENT CONCERNING PARTLY CLOSED CAVITIES BEHIND A SURFACE-PIERCING ROD

M. C. Meijer Jan. 1964 25 p refs

(Contract Nonr-220(43))

(E-110.1; AD-430179)

The post-base ventilation state occurring at surface-piercing rods was investigated. This state refers to a decrease in the size of the cavity, again forming a cavity closed at the water surface, when the speed of the piercing rod was increased over a certain level. Results indicate that the post-base ventilation state, as described by Thomsen, did not occur in the Free Surface Water Tunnel in a natural manner, although investigations were made at very low values of gH/U^2 and of d/H (g is the acceleration of gravity, H is the depth of submergence, and U is the velocity). However, post-base ventilation could be obtained by partial closure with a plate of the gap in the water surface. Removal of this plate always resulted in a restoration of the original base ventilated state if the velocity was high enough. It seems reasonable to suppose that in the case of Hay's experiment, such a plate or other spray cover near the surface must have been present, and became effective at high velocities when the spray sheet could make good contact with it. At the transition of the pre-base ventilation state and the base ventilation state, stable cavities did exist that were nearly closed near the water surface or at a lower point. I.v.L.

N64-18661 Emmanuel Coll., Boston, Mass. Research Language Center

THE EFFECT OF THE SAMPLING TIME WHEN DETERMINING THE MAXIMUM CONCENTRATIONS OF A GAS DIFFUSING IN A TURBULENT FLOW [DER EFFEKT DER MESSDAUER BEI DER ERMITTLUNG VON MAXIMALKONZENTRATIONEN EINES SICH IN TURBULENTER STROMUNG AUSBREITENDEN GASES]

F. Wippermann Bedford, Mass., AFCRL, Aug. 1963 48 p refs Transl. into ENGLISH from Intern. J. of Air and Water Pollution, v. 4, no. 1/2, 1961 p 1–23

(Contract AF 19(604)-8505)

(E-T-G-63-25; AD-429726)

The effect of sampling time is described as the correction factor that must be used when the "Immissionszeit" for the influence of the noxious gases of industrial waste is not in agreement with the observation time of the meteorological parameters. A statistical theory is presented to obtain quantitative statements for this effect of sampling time. With this in mind, the dependence of the meteorological parameters of the Sutton formula, on the time interval over which the means are taken, is investigated. It is shown that different mean intervals for the square of the velocity fluctuations in the vertical direction are insignificant for the effect of sampling time. A strong dependence on the mean intervals is shown for the mean velocity as well as for the square of the velocity fluctuations perpendicular to it. The orientation of the coordinate system depends also on the mean interval, since the Sutton formula requires orientation of the coordinate system in the direction of the mean flow. The application of the statistical theory requires knowledge of some characteristic values of the atmospheric flow. These are described. I.v.L.

N64-18662 Emmanuel Coll., Boston, Mass. Research Language Center

A PROCEDURE FOR DETERMINING MINIMUM CHIMNEY HEIGHTS [EIN VERFAHREN ZUR BESTIMMUNG VON SCHORNSTEINMINDESTHOHEN]

F. Wippermann and W. Klug Bedford, Mass., AFCRL, Sep. 1963 35 p refs Transl. into ENGLISH from Intern. J. Air Water Pollution, v. 6, 1962 p 27–48

(Contract AF 19(604)-8505)

(E-T-G-63-29; AD-430984)

A procedure is given that makes it possible to determine the minimum height of chimneys, such that a given maximum allowable concentration at ground level is not exceeded. The first part of the paper deals with the use of nomograms, and the second gives the theoretical basis of these nomograms; derivation of the formula used and determination of the meteorological parameters contained in it are given. Author

N64-18685 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

OSCILLATIONS OF A TWO-BAY PANEL IN GAS FLOW

Zh. K. Makhortykh 5 Dec. 1963 8 p refs Transl. into ENGLISH from Inzh. Sb. (Moscow), v. 28, 1960 p 51–54

(FTD-MT-63-143; AD-434990)

The oscillations of an elastic solid panel, with a supersonic flow of gas passing on one side and with a constant velocity in a negative direction, are described mathematically as a boundary-value problem. R.T.K.

N64-18688 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON THE INFLUENCE OF VORTICITY OF EXTERNAL FLOW AND CURVATURE OF BODY ON FLOW IN BOUNDARY LAYER

I. V. Petukhov and A. L. Ankudinov Transl. into ENGLISH from Inzh. Zh. (USSR), v. 2, no. 4, 1962 p 262–268

(FTD-MT-63-167; AD-434977)

A strict statement of boundary conditions is derived for secondary flows in a boundary layer. The approach to the problem is based on an accurate method of joining viscous and nonviscous flows. Thus, an external nonviscous flow and the surface of the body around which it flows (surface of displacement) are considered to be given at the time when changes in the form of the body, caused by the presence of a viscous near-wall layer, are not known. Results are given for the calculation of the correction of Blasius' solution as applied to an oblique flow around a plate. This correction was necessary in order to account for the influence of the vorticity of external flow on the flow in the boundary layer. I.v.L.

N64-18689 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

LAMINARY BOUNDARY LAYER ON A POROUS SURFACE

G. A. Kulonen 5 Dec. 1963 22 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., i Mekh. Astron., no. 13, 1960 p 115–130

(FTD-MT-63-168; AD-434976)

The laminar boundary layer problem both in the absence of a pressure gradient and with a pressure gradient on the porous surface is considered for the case in which the properties of the injected gas are identical or not too different from the properties of the free-stream gas. Crocco's variables are used for the case of the flat plate (zero pressure gradient). Differences of boundary-layer values for the porous surface and in the absence of the gas injection are introduced. The method of the linearization is used for the solution of the equations obtained. Author

N64-18717 Advisory Group for Aeronautical Research and Development, Paris (France)

MEASUREMENTS OF FLUCTUATING "STATIC" AND TOTAL-HEAD PRESSURE IN A TURBULENT WAKE

M. Strasberg (David Taylor Model Basin) Apr. 1963 32 p refs Presented at AGARD Specialists' Meeting on The Mech. of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963

(AGARD-464)

The spectra of the fluctuating "static" and total-head pressures have been measured in the turbulent wake behind a cylinder, at subsonic velocities and Reynolds number from 10^4 to 10^5, based on cylinder diameter. The spectra of the pressure are of the same form as the spectra of the longitudinal velocity fluctuations. The observed spectral magnitudes are compared with theoretical estimates. Possible sources of errors in the fluctuating pressure measurements are evaluated. Author

N64-18720 Advisory Group for Aeronautical Research and Development, Paris (France)

TURBULENCE IN THE NOISE-PRODUCING REGION OF A CIRCULAR JET

P. Bradshaw, D. H. Ferriss, and R. F. Johnson (Natl. Phys. Lab., Gt. Brit.) Apr. 1963 90 p refs Presented at the AGARD Specialists' Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963

(AGARD-450)

Measurements in a 2-in. cold air jet at M = 0.3 have shown that about a quarter of the Reynolds shear stress is produced by large eddies with a rather narrow range of wavelengths. It is deduced from the nine orthogonal spatial correlations that these eddies take the form of mixing jets, inclined to the radial direction in any cross-sectional plane. The same eddies appear to dominate the near-field pressure fluctuations. The large-eddy intensity and shear stress contribution decrease at distances from the exit of more than two or three diameters. The artificial modification of these well-defined eddies seems to offer the best hope of increasing the jet mixing rate and permitting noise reduction by the use of acceptably short ejector shrouds. Measurements leading to a turbulent energy balance are also described. Author

N64-18721 Advisory Group for Aeronautical Research and Development, Paris (France)

STATISTICAL PROPERTIES OF THE TURBULENT VELOCITY FLUCTUATIONS IN THE MIXING REGION OF A ROUND SUBSONIC JET

P. O. A. L. Davies and M. J. Fisher (Southampton U., Gt. Brit.) Apr. 1963 36 p refs Presented at the AGARD Specialists Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963 French summary

(AGARD-451)

It is well recognized that the noise sources in a jet can be related to the turbulent velocity fluctuations in the mixing region. The structure and characteristics of the turbulence have been studied experimentally, and the results are given in this report. It was found that the statistical characteristics of the turbulence can be expressed in terms of simple kinematic relationships as far as time-averaged quantities are concerned. Some results already published refer to axial correlations of axial velocity fluctuations, whereas the new results also include radial and circumferential correlations. It is logical to consider the variation of the measured velocity fluctuations about their mean values, as well as the time average quantities. Measurements are presented, which are expressed as probability distribution functions of the velocity about its mean value, or more simply as flatness and skewness factors.

Author

N64-18722 Advisory Group for Aeronautical Research and Development, Paris (France)

VELOCITY CORRELATION MEASUREMENTS IN THE MIXING REGION OF A JET

Marc A. Kolpin (M.I.T.) Apr. 1963 23 p refs Presented at the AGARD Specialists' Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963

(AGARD-452)

Measurements of space–time correlations of the u-component of turbulence in the mixing region of a jet are presented. It is shown that the longitudinal correlation function depends only on nondimensional quantities. On a given cylinder, the convection speed of the turbulent field was different for the different eddy sizes, varying from the local mean speed for small eddies to half the local mean exit speed for the large eddies. The lateral correlation function for zero time delay is shown to be monotonically decaying with increased wire separation. Measurements of the angular correlation function are reported that show no correlation of the fluctuations across the diameter of the jet. Author

N64-18723 Advisory Group for Aeronautical Research and Development, Paris (France)

ON CONVECTION VELOCITIES IN TURBULENT SHEAR FLOWS

J. A. B. Wills (Natl. Phys. Lab., Gt. Brit.) Apr. 1963 36 p refs Presented at the AGARD Specialists' Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963 Previously issued as N64-10018 01-11

(AGARD-457)

It is shown how the usual approach, through properties of the space–time correlations, to the convection velocity of turbulent motions in jets and boundary layers leads to difficulties of interpretation when the flow departs from rigid convection. A more rigorous approach in terms of a wave-number–velocity spectrum overcomes the difficulties, and allows the definition of a wave-number-dependent convection velocity that is relevant to studies of aerodynamic noise and wave generation in panels and in water. A simple experimental method for obtaining the spectrum is described, and measurements are presented for various radial positions in the shear layer of a circular jet, and for pressure fluctuations under a turbulent boundary layer. Author

N64-18725 Advisory Group for Aeronautical Research and Development, Paris (France)
SOME PRACTICAL APPLICATIONS OF BOUNDARY LAYER PRESSURE FLUCTUATION WORK
E. J. Richards and P. E. Doak (Southampton U., Gt. Brit.) Apr. 1963 46 p refs Presented at the AGARD Specialists' Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963
(AGARD-468)

This report consists of a general description of some practical applications of boundary-layer pressure fluctuation work and is aimed at indicating the next steps that need to be examined in the overall problem of boundary-layer noise. The first problem dealt with is that of the metal fatigue of structures due to turbulent boundary-layer pressure fluctuations on high-speed airliners. The question of internal noise levels in the cabin is discussed, and the method of calculation, or lack of method, is commented upon. The report also deals with noise radiated from the boundary layer in two specific cases; first, the radiated noise from an axial compressor, and, secondly, the radiated noise from a submarine hull. The grave deficiencies in knowledge are described, and experiments aimed at filling some of these gaps are outlined. Author

N64-18733* Douglas Aircraft Co., Inc., Long Beach, Calif.
WIND TUNNEL INVESTIGATION OF TURBULENT BOUNDARY LAYER NOISE AS RELATED TO DESIGN CRITERIA FOR HIGH PERFORMANCE VEHICLES
J. S. Murphy, D. A. Bies (Bolt, Beranek, and Newman, Inc.), W. W. Speaker, and P. A. Franken Washington, NASA, Apr. 1964 91 p refs
(NASA Contract NASr-110)
(NASA TN D-2247) OTS: $2.25

Experimentally determined data on the magnitude of wall pressure fluctuation levels for turbulent boundary layers are presented in this report. The measurements were made on the sidewall of the Trisonic One-Foot Tunnel, which was modified to eliminate background noise in the test stream normally associated with choked flow over the pressure control valve. A small condenser microphone was used that limited measurements to frequencies below 88,000 cps, a range to which practical vehicle structure can respond. Results are presented for the zero pressure gradient or flat plate boundary layer on an insulated surface for free-stream Mach numbers of 0.43, 0.59, 0.86, 1.41, 1.80, 2.52, and 3.46 and Reynolds number based on momentum thickness in the range $14 \times 10^3 < R_\theta < 50 \times 10^3$. Author

N64-18735* Ling-Temco-Vought, Inc., Dallas, Tex.
SIMILAR SOLUTIONS OF THE BOUNDARY LAYER EQUATIONS FOR PURELY VISCOUS NON-NEWTONIAN FLUIDS
C. Sinclair Wells, Jr. Washington, NASA, Apr. 1964 36 p refs
(NASA Contract NASw-792)
(NASA TN D-2262) OTS: $1.00

The boundary-layer equations for flows of purely viscous non-Newtonian fluids are investigated for the purpose of obtaining all possible conditions for which similar solutions exist. Both steady and unsteady flows are investigated. The momentum transport model is the Ostwald–de Waele (power law) formulation, which predicts shear-thinning, shear-thickening, and the special case of Newtonian fluids. The similar solutions obtained represent, in all cases, generalizations of boundary-layer flows of Newtonian fluids. The solutions are discussed with respect to application to physical flows. Some of the more familiar flows represented are: steady flow over a flat plate, a wedge, and a stagnation region; steady flow in a convergent or divergent channel; and impulsively started flow over an infinite flat plate and a semi-infinite flat plate. Author

N64-18755 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING CERTAIN PECULIARITIES OF AVERAGING OF PARAMETERS IN A SUPERSONIC GAS FLOW
A. Ya. Cherkez 15 Jul. 1963 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1962 p 23–26
(FTD-MT-63-51/1+2; AD-434965)

The mean values of the parameters, constancy of total energy, entropy, and gas expenditure, in a nonuniform gas flow with parallel speed vectors in all points of a considered cross section are determined. These parameters will simultaneously satisfy the condition of the conservation of momentum in original and averaged flow. I.v.L.

N64-18763 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE SOLUTION OF THE EQUATION FOR VON MISES' BOUNDARY LAYER THEORY
A. L. Dyshko 20 Nov. 1963 13 p refs Transl. into ENGLISH from Vychislitel'naya Mat., AN SSSR (Moscow), v. 7, 1961 p 181–186
(FTD-MT-63-170; AD-434975)

The motion of a viscous incompressible liquid in the boundary layer of a plate is determined by the given von Mises' equation. This report presents a stable difference scheme for solving the equation. I.v.L.

N64-18774 Aberdeen Proving Ground, Md. Ballistic Research Labs.
THE FREE FLIGHT STABILITY OF A LIQUID-FILLED, SPINNING SHELL. PART 2a: SPINNING, INCOMPRESSIBLE, INVISCID LIQUID, COMPLETELY FILLED, RIGHT CYLINDRICAL CAVITY
W. E. Scott Dec. 1963 35 p refs
(BRL-1233; AD-435694)

The differential equation of yawing motion for a spinning shell in free flight, containing a cylindrical cavity completely filled with a liquid, and spinning uniformly at the same constant rate as the shell, is derived by use of the Euler-momentum equation. An approximate solution is obtained, and it is shown that the liquid can destabilize the yawing motion. This destabilizing effect is a function of an integral of yawing velocity and has no counterpart in aerodynamic or ballistic theory, since it is due to oscillations within the liquid. This destabilization is greatest if one of the modes of oscillation of the liquid has a frequency near one of the frequencies of the yawing motion. Author

N64-18825 Stanford U., Calif.
TOPICS IN HYPERSONIC FLOW THEORY
Jean-Pierre Guiraud May 1963 318 p refs
(Contract AF 49(638)-965)
(SUDAER-154)

The following are discussed: (1) small-disturbance theory; (2) Newtonian approximation theory; (3) the blunt-body problem; and (4) applications of characteristic theory to some hypersonic problems—general considerations, flows with chemical kinetics, and the shock-expansion method. R.T.K.

N64-18852 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
FUNDAMENTAL INVESTIGATION OF NONSTEADY AND NONEQUILIBRIUM FLOW
G. Rudinger *In* Va. U. Project Squid 1 Apr. 1964 p 1–5 refs (See N64-18851 11-24)

Two-phase flows are being investigated in which a gas carries along a large number of small particles that are evenly distributed over the cross section of a duct. So far, the drag coefficients have been determined from the particle trajectories on the streak records, the velocity of the shock wave, and the measured pressure variations in the relaxation zone. The gas temperature in the observed part of the relaxation zone was assumed to be constant. This assumption may be used instead of the recorded pressure variations for the computation of the drag coefficient. The available records were reevaluated in this manner, and the results indicated substantially the same correlation between drag coefficient and particle Reynolds number as was originally obtained, except that the experimental points are displaced along the correlation line. Only the points immediately behind the shock wave are unaffected, since both the drag coefficient and the Reynolds number for these points can be found from the particle trajectory and the shock velocity without additional measurements or assumptions. The drag coefficients obtained thus far differ considerably from customary assumed values. Attempts to explain this difference are discussed. I.v.L.

N64-18854 Princeton U., N.J.
SHOCK WAVE SEPARATION IN GAS MIXTURES
J. B. Fenn, D. G. Marsden, J. H. Cheng, and A. L. Cooper *In* Va. U. Project Squid 1 Apr. 1964 p 11–13 refs (See N64-18851 11-24)

This program comprises an investigation of the species separation in small supersonic jets. The immediate experimental objective centers around measurements of the separation effect under conditions that are amenable to theoretical analysis. In conjunction with this objective, a nozzle-chamber-probe apparatus has been designed and is under construction. This apparatus will make use of an available high-speed pumping system sufficient to maintain the background pressure as low as one micron or less. Theoretical effort has been limited to exploring a simple two-fluid model of the shock-wave stagnation region. In this model it is assumed that both of two species are at the same temperature and velocity when they enter the stagnation region. The species are characterized by different Mach numbers because they have different molecular weights. It is assumed that each of the species then behaves as if it were alone, and its stagnation density, corresponding to its own particular Mach number, is computed. This model provides some enrichment of heavy species in the stagnation region but not as much as has been observed. If it is further assumed that the two species, heretofore completely independent, come to thermal equilibrium in the stagnation region, an enhancement of separation occurs and exceeds the values measured thus far. I.v.L.

N64-18875 Stevens Inst. of Tech., Hoboken, N.J.
AN INVESTIGATION OF MIDSHIP BENDING MOMENTS EXPERIENCED IN EXTREME REGULAR WAVES BY MODELS OF THE MARINER TYPE SHIP AND THREE VARIANTS
First Progress Report
J. F. Dalzell 15 Jan. 1964 63 p refs
(Contract NObs-78211)
(SSC-155; PB-181508; AD-432278) OTS: $1.75

The experiments included variation of distribution of loading and of freeboard as model parameters. Each variation was tested at various speeds in regular head and following waves of several different lengths and of a wide range of heights. No significant upper limit of bending moment was found. However, the study establishes more firmly the grossly linear dependence of midship bending moment on wave height, even for extreme wave heights that may be encountered in service. These findings strengthened the case for determining design wave bending moments on the basis of statistical analyses of ocean waves and/or resulting bending moments. Author

N64-18953* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF CONTROLLED SURFACE ROUGHNESS ON BOUNDARY-LAYER TRANSITION AND HEAT TRANSFER AT MACH NUMBERS OF 4.8 AND 6.0
Paul F. Holloway and James R. Sterrett Washington, NASA, Apr. 1964 47 p refs
(NASA TN D-2054) OTS: $1.25

An investigation has been conducted at a free-stream Mach number of 6.0 to determine the effects of controlled three-dimensional surface roughness (spheres) on boundary-layer transition and heat transfer. Experimental data are presented for a sharp-leading-edge two-dimensional flat-plate model over a local unit Reynolds number range of 1.2×10^6 to 8.2×10^6 per foot based on a local Mach number of 6.0 and 9.8×10^6 to 13.9×10^6 per foot based on a local Mach number of 4.8. The Reynolds number for natural transition has been found to increase markedly with increasing Mach number above a Mach number of approximately 3.7. It was found that surface roughness of height less than the boundary-layer thickness can delay transition. The critical roughness Reynolds numbers determined experimentally in this investigation are larger than those found at lower supersonic Mach numbers. Author

N64-18992 Advisory Group for Aeronautical Research and Development, Paris (France)
AN EXPERIMENTAL INVESTIGATION OF TURBULENCE-EXCITED PANEL VIBRATION AND NOISE (BOUNDARY-LAYER NOISE)
M. Y. el Baroudi, G. R. Ludwig and H. S. Ribner Apr. 1963 40 p refs Presented at the AGARD Specialists' Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genese, Belgium, 1–5 Apr. 1963
(AGARD-465)

A detailed study has been made of the flexural motion and noise generated by 11- × 11-in. steel panels flush-mounted in the wall of a turbulent flow channel. The mean-square exciting pressure fluctuation at the wall, its spectral density, and two-point correlations of the pressure were measured with the use of pinhole microphones. The flexural response of sample panels was studied by correlation techniques. The calculated relief plot of correlation shows qualitative agreement with the experimental results. Author

N64-18994 United Nuclear Corp., White Plains, N.Y. Development Div.
SELECTED PARAMETERS FOR TWO-PHASE FLOW OF SODIUM
Kurt Goldmann 16 Aug. 1963 15 p refs Presented at the 3rd Ann. High-Temp. Liquid-Metal Heat-Transfer Tech. Conf., ORNL, Sep. 4–6, 1963
(Contract AT(30-1)-2303)
(PS-186)

The present paper presents selected two-phase flow parameters for sodium systems. They are based on analytic techniques that previously have proved useful for water systems. Flow pattern charts are developed, and two-phase pressure drop and vapor-volume fraction data are presented. Author

N64-19089 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
LAMINAR BOUNDARY LAYERS WITH INJECTION OF ANOTHER MEDIUM (TWO FLUID BOUNDARY LAYERS) [LAMINARE GENZSCHICHTEN BEI AUSBLASEN EINES ANDEREN MEDIUMS (ZWEISTOFFGRENZSCHICHTEN)]
W. Wuest London, Min of Aviation, Jan. 1964 38 p refs Presented at the Intern. Congr. of Appl. Mech., Stresa, Italy, 1960 Transl. into ENGLISH from Ing.-Archiv. (Berlin), v. 33, no. 2, 1962 p 125–143
(RAE-TRANS-1055)

It is shown that the continuity equation and the boundary-layer approximation of the momentum equation applicable to the case where one gas is injected into the boundary layer of a different gas are unaltered in form compared with the case where both gases are identical. Variable physical properties are incorporated into the differential equations by using semiempirical approximation formulas. Similar solutions are possible only in the case of the flat plate at a given Mach number, and with the injection velocity inversely proportional to the square root of the distance from the leading edge. Author

N64-19135 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CHEMICALLY REACTING BOUNDARY LAYERS
Michael Lenard Mar. 1964 41 p refs Presented in part at 8th Symp. on Ballistic Missile and Space Technol., San Diego, 16–18 Oct. 1963
(Contract AF 04(694)-222)
(R64SD14; AD-435741)

Numerical calculations of the chemically reacting laminar air boundary-layer equations are presented at several points along cone-shaped reentry bodies at several flight conditions and different wall temperatures. These results use a 7-component, 10-reaction model of air (N, O, N_2, O_2, NO, NO^+, e^-). Thermodynamic and transport properties are completely general and use the latest available information. The solutions are based on the assumption of local similarity. The resulting electron densities are noted. Author

N64-19141 Polytechnic Inst. of Brooklyn, N.Y.
ON THE COMPRESSIBLE LAMINAR BOUNDARY LAYER WITH SUCTION
Morris Morduchow and Stanley P. Reyle Oct. 1963 67 p refs
(AF-AFOSR Grant 1-63)
(PIBAL-807; AD-436886) OTS: $6.60 ph

The compressible laminar boundary layer in a pressure gradient with suction has been analyzed by means of the momentum and thermal integral equations in conjunction with sixth and seventh degree velocity profiles, and seventh degree stagnation enthalpy profiles. For flows with and without a pressure gradient, approximate but comparatively simple methods of calculating the boundary layer for a given Mach number, a given uniform wall temperature, and a given suction distribution are shown. The results thus obtained agree well with a variety of exact or purportedly accurate solutions, including the exact asymptotic suction solutions for compressible flows with a pressure gradient and heat transfer. Author

N64-19160 Douglas Aircraft Co., Inc., Long Beach, Calif.
SOLUTION OF THE INCOMPRESSIBLE LAMINAR BOUNDARY-LAYER EQUATIONS
A. M. O. Smith and Darwin W. Clutter 1 Jan. 1963 62 p refs
(Contract NOw-60-0533c)
(Eng. Paper 1525)

A general method is presented for calculation of the incompressible steady laminar boundary layer around either a two-dimensional or an axially symmetric body. The method is a modification of the Hartree–Womersley method. It consists of replacing the partial derivatives with respect to the flow direction by finite differences, while retaining the derivatives in a direction normal to the boundary, so that the partial differential equation becomes approximated by an ordinary differential equation. Reasons for choosing this method rather than the more conventional finite-difference methods are discussed. Author

N64-19162 Douglas Aircraft Co., Long Beach, Calif.
SOLUTION OF PRANDTL'S BOUNDARY-LAYER EQUATIONS
A. M. O. Smith and Darwin W. Clutter 2 Feb. 1963 66 p refs
(Contract NOw-60-0533c)
(Eng. Paper 1530)

Described is a method for solving the equation of steady incompressible, laminar-boundary-layer flow over axially symmetric and two-dimensional bodies. The method requires use of a large-scale automatic digital calculator. Basically it is the Hartree–Womersley procedure, which converts a partial differential equation in two independent variables x and y into an ordinary one in y only. This conversion is accomplished by replacing the x-derivatives by various finite-difference equivalents. The resulting ordinary differential equation is solved to meet the boundary conditions imposed by the problem at any station x_n. Once solved, the differential equation is solved again at a new location x_{n+1} a short distance downstream, where it is subject to new boundary conditions. The procedure continues until the entire flow is traversed. The differential equations are uncoupled, that is, they are solved one by one, not simultaneously. Author

N64-19197 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CLASSIFICATION OF FLOWS IN AIR SHOCK TUBES
G. M. Arutyunyan 1 May 1963 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekh. i Mashinostr. (Moscow), no. 2, 1961 p 106–111
(FTD-TT-63-309/1+2+4; AD-407941)

Examined are the possible types of flow (1) with constant pressure behind the front of a shock wave and (2) with arbitrary variation of initial pressures in the sections of the shock tube and of the geometric dimensions of the tube. It is assumed that the low-pressure section of the shock tube has an open end. Author

N64-19212 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TURBULENT BOUNDARY LAYER IN A GAS FLOW WITH HEAT TRANSFER AND A PRANDTL NUMBER DIFFERENT FROM UNITY
Yu. V. Lapin 14 May 1963 16 p refs Transl. into ENGLISH from the book "Tekhnicheskaya Gidromekhanika" Moscow, Gos. Neuchno-Tekhn. Izd. Mashinostr. Lit., 1961 p 27–36
(FTD-TT-63-284/1+2+4; AD-405720)

A solution is obtained for the flow of a gas with a moderate pressure gradient and with an arbitrary temperature distribution, since the von Kármán semiempirical theory is used. The influence of the pressure gradient is calculated across the external flow only. The temperature range examined is that in which the Prandtl number and the specific heat can be considered constant, regardless of the temperature. The analytical expression for the parameter $H = \delta^*/\delta^{**}$, depending on the conditions at the wall and at the external boundary layer, is obtained. The H is the integral thickness of the boundary layer in the case of the flow of an incompressible gas without heat transfer, δ^* is the displacement thickness, and δ^{**} is the momentum loss thickness. Also, a formula is derived for calculating friction that does not require the use of various types of auxiliary graphs and tables. The calculation of heat transfer was based on Reynolds' analogy. I.v.L.

N64-19217 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

TAKING INTO ACCOUNT THE MOLECULAR COMPOSITION OF AIR IN CALCULATIONS OF AERODYNAMIC FORCE COEFFICIENTS AND BODY TEMPERATURE IN FREE-MOLECULE FLOW AT HIGH SUPERSONIC VELOCITIES

V. S. Galkin 24 Apr. 1963 6 p refs Transl. into ENGLISH from Inzh. Zh. (USSR) v. 1, no. 1, 1961 p 175–176
(FTD-TT-63-361/1+2+4; AD-405693)

It is shown that, for a high supersonic flight velocity and a flight altitude greater than 150 km, the aerodynamic forces and the kinetic energy flow of the particles impinging on the body can be calculated by assuming the air to be a single component gas with the same density, temperature, and average molecular weight. It is also shown that the same assumptions can be made for more moderate flight velocities, with a resulting accuracy of approximately 3%. P.V.E.

N64-19235* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE CORRELATION OF OBLIQUE SHOCK PARAMETERS FOR RATIOS OF SPECIFIC HEATS FROM 1 TO 5/3 WITH APPLICATION TO REAL GAS FLOWS

Mitchel H. Bertram and Barbara S. Cook Washington, NASA, Dec. 1963 73 p refs
(NASA TR R-171) OTS: $1.75

An analytic investigation was made to show the extent of correlation of the exact oblique shock parameters that may be accomplished by means of similarity parameters suggested by approximate theory. The exact theory for the inviscid flow of a perfect gas was calculated for Mach numbers of 1.1 to 40, ratios of specific heats from 1 to 5/3, and angles-of-attack from 0° to shock detachment. From consideration of the approximate theory and the concept of effective ratio of specific heats, the oblique shock correlations were found to be useful for the rapid calculation of many flow parameters for an equilibrium real gas. Some useful correlations are also given for the case of isentropic expansion around a sharp corner. Author

N64-19246 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.

LINEARIZED VORTEX FLOWS

W. S. Lewellen 24 Apr. 1964 36 p refs
(ATN-64(9227)-4)

Steady vortex flows driven by a radial convection of angular momentum are considered. The incompressible Navier–Stokes equations are linearized by considering perturbations about both simple, nonrotating flows and strongly rotating flows; i.e., the equations are expanded for large and small Rossby numbers. Axial variations in a swirl superimposed upon a stagnation-point flow (with radial inflow) are considered for large Rossby numbers. An analytic solution is found for the axial decay of a given swirl. By considering flows for small Rossby numbers, it is found that in flows dominated by rotation, the fluid motion is forced to be two-dimensional except in thin shear regions where necessary adjustments imposed by boundary conditions are made. The properties of these different shear layers are dependent on the gradient of the basic circulation of the flow as well as the Reynolds number. Author

N64-19250 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

AERODYNAMIC COMPRESSION OF A GAS STREAM

Ye. D. Nesterov 4 Jan. 1963 15 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeni. Aviats. Tekh. (USSR), no. 1, 1962 p 82–91
(FTD-TT-62-1555/1+2+4; AD-295777)

The interaction of two streams of compressible fluid directed at an angle to one another is examined. The main stream of gas is compressed by an active stream, which is supplied through an annular slit, located in the region of minimum cross section of the main stream. Ratios of aerodynamic compression are derived for two cases: a convergent channel and a Laval nozzle. The difference between these two cases is that in a divergent channel the separation zone is in communication with the atmosphere, and in a Laval nozzle it is a closed region. This gives unique conditions for solution of the problem. Author

N64-19268 California U., Berkeley Inst. of Engineering Research

AN INTEGRAL INVARIANT OF A CLASS OF STEADY-STATE VISCOUS-INCOMPRESSIBLE FLOWS

Paul Lieber and Koon-Sang Wan (GE) Nov. 1963 17 p refs (Contract Nonr-222(87))
(MD-63-3; AD-428024)

Conditions for and properties of the invariance of an integral that represents a global measure of uniformity of a class of steady-state viscous incompressible flows are discussed. Steady-state flows are defined as flows subjected to prescribed and time-constant velocities on a surface S enclosing a simply or multiply connected flow domain V. The properties of the integral established and reported here are valid either for time-independent or time-dependent flows in V, and therefore apply, in particular, to turbulent flows produced under time-independent boundary conditions. The invariant identified points mathematically to necessary connections between spatial symmetry and time-dependent motion evolving under time-independent boundary conditions. It is the basis for identifying a linear substructure of the Navier–Stokes equations. R.T.K.

N64-19291* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

TRANSPORT EQUATIONS FOR A PARTIALLY IONIZED GAS IN AN ELECTRIC FIELD

Peter M. Sockol Washington, NASA, Apr. 1964 22 p refs
(NASA TN D-2279) OTS: $0.50

Transport equations for a partially ionized gas in an electric field are derived from the Boltzmann equation by the Grad 13-moment method. Charged-particle interactions are described by Coulomb forces; all other particle interactions are described by a rigid elastic sphere model. First approximations to currents, stresses, and heat fluxes are obtained. The resulting transport relations are suitable for use in situations where the electrons have an elevated temperature. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-18586 Innsbruck U. (Austria)
HORIZONTAL MAGNETIC DIPOLE IN A CONDUCTING EARTH Technical Note No. 6
G. Tinhofer 25 Nov. 1963 19 p refs
(Contract AF 61(052)-490)
(AFCRL-64-144; AD-434775)

The VLF radiation field of a horizontal magnetic dipole (placed at a depth h below the plane ground) in conducting earth, is calculated by means of the theory of functions (integral method). It is shown that the effect of the ionosphere in the region of primary excitation, as well as the displacement current, can be neglected. Author

N64-18635 London U. (Gt. Brit.) Queen Mary Coll.
A THEORETICAL INVESTIGATION OF DIFFUSION IN RAREFIED GASES Technical (Final) Report
V. C. A. Ferraro, J. E. C. Gliddon, and P. C. Kendall (Sheffield U.) 30 Sep. 1963 87 p refs
(Contract AF 61(052)-299; AF EOAR Grant 61-41)
(AFCRL-64-75; AD-434790)

Investigations on the effects of vertical diffusion and drift in the F2 region were completed. The effect of the geomagnetic field on diffusion in the F2 region near the geomagnetic equator was investigated. This investigation was extended in order to estimate the importance of electrodynamic drift. A convenient method is shown for calculating the distribution of hydrogen and helium ions in the exosphere on the assumption of thermodynamic equilibrium. Author

N64-18664 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXPERIMENTAL RESEARCHES OF SPECTRAL TRANSPARENCY OF ATMOSPHERE
Yu. I. Rabinovich and L. N. Guseva 19 Aug. 1963 13 p refs Transl. into ENGLISH from Issled. Radiats. Protsessov, Trudy. Glavnaya Geofiz. Observ. (Leningrad), no. 118, 1961 p 69–76
(FTD-MT-63-16/1+2; AD-434949)

Results of the spectral measurements of direct solar radiation in visible region of the spectrum are presented. An analytic relation between the spectral and the general coefficients of transparency is presented. Author

N64-18751 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING DEPENDENCE OF AMPLITUDE OF SEISMIC OSCILLATIONS ON WEIGHT OF CHARGE
I. I. Gurvich and Chzhao Bin 12 Jul. 1963 12 p refs Transl. into ENGLISH from Priklad. Geofiz. (Moscow), no. 30, 1961 p 12–18
(FTD-MT-63-36/1+2; AD-434941)

Seismographic recordings were obtained to demonstrate the dependence of the frequency of oscillations on the weight of charge used to obtain an explosion. R.T.K.

N64-18768 Lockheed-California Co., Burbank
RESEARCH ON SOLAR MAGNETIC FIELDS Semi-Annual Technical Summary Report No. 2, 1 Aug. 1963-31 Jan. 1964
D. S. Webber 19 Feb. 1964 6 p
(Contract Nonr-3933(00); ARPA Order 215, Amend. 4)
(AD-433517)

Progress was made on the following tasks: (1) the survey and reduction of Mount Wilson magnetic-field data; (2) the analysis of the solar magnetic fields; and (3) the correlation of solar magnetic-field configurations and changes with chromospheric phenomena. R.T.K.

N64-18884 Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SHEAR STRESS MEASUREMENTS IN SITU OF SOILS SUBJECTED TO VIBRATORY LOADS
Rudolf K. Bernhard (Princeton U.) Nov. 1963 16 p refs
(CRREL Tech. Rept. 90; AD-433800)

Direct measurements of shear and normal stresses were made, the compatibility of the resulting shear stress distribution and the corresponding normal stress pattern was studied, and the experimental findings were correlated with the existing theories for biaxial systems. A miniaturized shear cell was employed, and the results of measurements in situ with this shear cell are compared with those of pressure cells. Vibratory (sinusoidal) loads were generated by a mechanical oscillator on the soil surface and transmitted to both types of cells buried beneath the oscillator. A predominantly homogeneous and noncohesive soil (dry beach sand) was used, so that the theory for biaxial stress distribution could be applied as a first approximation in the analysis. Author

N64-18889 Naval Weapons Lab., Dahlgren, Va.
CALIBRATION OF DOPPLER SATELLITE OBSERVATIONS BY SHORT ARC SOLUTION FOR STATION COORDINATES
E. H. Nott 18 Mar. 1964 19 p
(NWL-1908; AD-433978)

Results were obtained using the short-arc method to determine station coordinates for calibrating the Doppler instrumentation used in determining geodetic parameters from satellite observations. The coordinates obtained were within three standard deviations of surveyed station coordinates in most cases. Since this represented differences of 5 to 10 meters, depending on the relative positions of the stations when 24 arcs were combined, it is concluded that Doppler data processed by the short-arc method give a reliable estimate of station positions. Author

N64-18963 Joint Publications Research Service, Washington, D.C.

PROBLEMS OF ENGINEERING SEISMOLOGY, NO. 8 [VOPROSY INZHENERNOY SEYSMOLOGII 8]

6 Apr. 1964 207 p refs Transl. into ENGLISH of Tr. Inst. Fiz. Zemli, Akad. Nauk SSSR (Moscow), no. 28 (195), 1963 p 3–146

(JPRS-24051; OTS-64-21995) OTS: $3.50

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1. ON THE SEISMIC MICRO-REGIONING OF THE TERRITORY OF PETROPAVLOVSK-KAMCHATSKIY A. V. Goryachev, I. A. Yershov, F. A. Kirillov, I. P. Kuzin, G. A. Lyamzina et al p 1–82 refs

2. BULLETIN OF STRONG EARTHQUAKES IN THE USSR IN 1960 N. A. Vvedenskaya, V. K. Iodko, N. V. Kondorskaya, N. S. Landyreva, L. A. Misharina et al p 83–104 refs

3. BASIC SEISMOLOGICAL DATA USED IN THE DETAILED SEISMIC REGIONING OF THE VALLEY OF THE RIVER VAKHSH V. I. Bune p 105–123 refs

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6. ON THE INSTRUMENTAL DETERMINATION OF ENGINEERING SPECTRA D. P. Kirnos, Yu. A. Kolesnikov, and L. A. Kogan p 146–163 refs

7. GRAPHS OF RECURRENCE OF PERIODS IN EARTHQUAKES OF VARIOUS INTENSITY L. A. Skorik p 164–167 refs

8. PRACTICAL METHODS OF CALCULATING THE MAIN FORMS OF OSCILLATIONS FOR SYSTEMS WITH SEVERAL DEGREES OF FREEDOM M. G. Korf p 168–175

9. OSCILLATIONS OF ARCH DAMS DURING A SEISMIC DISTURBANCE S. V. Medvedev and A. P. Sinitsyn p 176–186 refs

10. SELECTION OF DYNAMIC EQUIVALENCE FOR A SEISMIC DISTURBANCE WITH AN INTENSITY OF 7 M. G. Korf p 187–194 refs

11. THE BEHAVIOR OF BUILDINGS LOCATED ON DIFFERENT SOILS DURING THE PASSAGE OF A SEISMIC WAVE S. V. Puchkov p 195–203 refs

N64-18982 Joint Publications Research Service, Washington, D.C.

THE "ELEKTRON" STUDIES THE EARTH'S RADIATION BELT

28 Apr. 1964 6 p Transl. into ENGLISH from Priroda (Moscow), Feb. 1964 p 114–116

(JPRS-24378; OTS-64-31169) OTS: $0.50

The scientific stations "Elektron-1," with an apogee of 7,000 km, and "Elektron-2," with an apogee of 70,000 km, were successfully launched by the Soviet Union on January 30, 1964. These stations carry out simultaneous research on the radiation belts of the earth and the physical phenomena related to them, according to a single program. This program will study the high- and low-energy particles that make up the earth's radiation belts, the magnetic fields of the earth and of the radiation belts, cosmic rays, the chemical composition of the outer space around the earth, the shortwave radiation of the sun, the radiofrequency emission of the galaxies, and micrometeorites. Research conducted thus far has shown that when the earth falls into the corpuscular beams produced by the sun, i.e., during the appearance of magnetic storms and the aurora borealis on the earth, marked changes occur in the earth's external radiation belt. It is during this time that the "circumterrestrial space particle accelerator" begins to work. Ballistically, these scientific stations can stay aloft for many years, however, it is difficult to say how long communications will exist, since it is impossible to know what the effect of the radiation belts on the instruments will be. I.v.L.

N64-19004 Federal Aviation Agency, Washington, D.C. Air Traffic Control Development Div.

NAS CHART OVERLAYS FOR THE SYSTEM DESIGN TEAM, SUPPLEMENT NO. 1

Harry L. Lamb Feb. 1964 84 p refs

(RD-64-26, Suppl. 1)

This report supplements the Memorandum Report, NAS—Chart Overlays for the System Design Team, July 1963, by presenting one-half size reproductions of seven additional transparent film overlays. The reproductions in this supplement fit into the categories described in the basic report as follows: U.S. Base Map (1 chart), Air Traffic Control (4 charts), and Communications (2 charts). The appendix contains the data used to construct the overlays in the Communications category. Author

N64-19090 National Bureau of Standards, Boulder, Colo.

TABLES OF MEDIANS OF IONOSPHERIC DATA, JULY 1963-MARCH 1959

Feb. 1964 26 p Abstracted from CRPL-F (Pt. A)

Tables of medians of ionospheric data are given for locations throughout the world. R.T.K.

N64-19125 Radio Corp. of America, New York, N.Y. Communications Systems Div.

MICROWAVE RADIO RELAY. IONOSPHERIC TRANSMISSION MODELS, TASK 5 Final Report, 28 Mar.-30 Sep. 1963

M. Masonson, A. Schmidt, and S. Weber 30 Sep. 1963 256 p refs

(Contract DA-36-039-SC-87240)

(CR-63-419-12; AD-436390)

This report covers the following: (1) Rayleigh fading and normal noise; (2) development of power spectra and correlation functions required to describe a fading carrier in a noise background; (3) actual error-rate analysis; (4) specular component, multipath overlap, and minimum-error combiners; and (5) experimental data on the stability of carrier phase over a high frequency circuit. Appendixes provide (1) a resumè of literature on high frequency transmission; and (2) the properties and applications of an integral that arises in the evaluation of pulse-shift-keyed (PSK) error-rates when a specular component is introduced. E.W.

N64-19148* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SIMULTANEOUS ROCKET AND SATELLITE MEASUREMENTS OF THE TOPSIDE IONOSPHERE

S. J. Bauer, L. J. Blumle, J. L. Donley, R. J. Fitzenreiter, and J. E. Jackson Repr. from J. Geophys. Res., v. 69, no. 1, 1 Jan. 1964 p 186–189 refs

(NASA RP-158)

Compared are the electron density profiles obtained by the topside sounder of the Alouette satellite (1962 Beta Alpha 1) with similar data obtained with an Argo D-4 rocket launched from Wallops Island, Va., July 2, 1963, to intersect the Alouette orbit. This rocket carried two proven experiments, each yielding independently the charged-particle distribution in the topside ionosphere. The electron density was measured by the well-established two-frequency CW propagation technique. The ion density profile was measured by an ion retarding potential experiment employing a planar ion trap similar to that used in past rocket and satellite experiments. A comparison of charged-particle profiles obtained by rocket, satellite, and ground based incoherent backscatter measurements is shown graphically.
IAA

N64-19149* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HYDROGEN DIFFUSION IN THE THERMOSPHERE BY MONTE CARLO METHOD
S. O. Kastner Repr. from J. Geophys. Res., v. 69, no. 1, 1 Jan. 1964 p 157–164 refs
(NASA RP-159)

Application of the Monte Carlo method to the problem of hydrogen diffusion in the thermosphere, to avoid hypotheses such as that of hydrostatic equilibrium, and to simulate actual collisions as closely as possible, is presented. The resulting density distribution has a steeper gradient than current theories predict, including omission of gravity. The departure is ascribed to increasing nonvalidity of the Chapman–Enskog diffusion coefficient as density changes over a mean free-path become significant.
IAA

N64-19211 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE NEW FORMULA OF THE INTENSITY OF RADIATION AND NEW CHARACTERISTICS OF THE TRANSPARENCY OF THE AIR
Kh. Myurk 25 Apr. 1963 9 p refs Transl. into ENGLISH from the book "Issledovaniya po Fizike Atmosfery" Tallinn, Est., Acad. Sci. 1959 p 7–14
(FTD-TT-63-178/1+2; AD-405719)

A formula for the intensity of the integral radiation of the sun is derived. In this derivation, it is assumed that the coefficient of the weakening of the integral radiation, with invariable transparency of the atmosphere, is a function of the number of masses m. After determining the suitable conditions relative to the weakening of the integral radiation, it was possible to derive a formula of intensity in sufficient agreement with actuality. This formula, $S_m = S_0 p_1^m m^{Bm}$, contains a magnitude, B, which is almost independent of m and which can be considered as a new characteristic of the atmosphere. I.v.L.

N64-19225* California U., La Jolla Space Sciences Lab.
THE RADIATION BELTS, NATURAL AND ARTIFICIAL
C. E. Mc Ilwain Repr. from Science, v. 142, no. 3590, 18 Oct. 1963 p 355–361 refs
(NASA Contract NAS5-3063; NASA Contract NASr-116)

Data on the time- and space-dependence of trapped particles in three categories have been obtained by detectors on the Explorer XV satellite. Observations are as follows. There is an unexpected secondary peak in the distribution of high-energy protons. The fluxes of high-energy protons slowly increased with time, but apparently were not affected by geomagnetic events, which caused perturbation of the electron fluxes on the same lines of force. About 1% or 2% of the electrons generated by nuclear detonation were found to be present in the geomagnetic field 125 days later. The electron fluxes in the region between L = 1.25 and 1.65 earth radii varied by less than 35% over the period from day 110 to day 206 after the detonation. The spatial distributions of high- and low-energy electrons are quite different. Electrons in the region above L = 1.7 earth radii are strongly perturbed by magnetic disturbances. A "new" outer zone of both high- and low-energy electrons was formed by a magnetic storm.
Author

N64-19284 Bureau of Mines, Spokane, Wash. Mining Research Lab.
DETERMINATION OF PRINCIPAL STRESS DIRECTIONS THROUGH AN ANALYSIS OF ROCK JOINT AND FRACTURE ORIENTATIONS, STAR MINE, BURKE, IDAHO
E. W. Gresseth 1964 48 p refs
(BM-RI-6413)

The orientation of in situ rock fractures and joints formed a pattern that could be used to determine the direction and effect of ground forces in a complex formation. Joint and fracture systems surrounding underground openings of the Star Mine, Burke, Idaho, were identified and classified. These were plotted on a point diagram to show their in situ orientations and to facilitate their classification into systems. They were also classified as tensional or shear; and by the use of strain ellipsoid techniques, the direction of the principal stresses of the in situ rock was determined. Results indicate at least two periods of rock deformation. The first of these two periods occurred during folding, when the maximum ground force was horizontally oriented in an east-southeasterly, west-northwesterly direction. The most recent period of deformation appeared to be associated with stoping, and indicated that the maximum ground force acted horizontally in a general north-south direction.
Author

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-18606 ARO, Inc., Arnold Air Force Station, Tenn.
LOCAL HEAT-TRANSFER COEFFICIENTS IN A NOZZLE WITH HIGH-SPEED LAMINAR FLOW
William H. Carden Arnold Eng. Develop. Center, Apr. 1964 42 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-61; AD-434369)

An experimental investigation of the local heat-transfer coefficient in the throat region of a nozzle operating under conditions of cold wall, thick, laminar boundary-layer, low-density, high-speed flow has been conducted. The experimental results have been compared with several analytic procedures for predicting the heat-transfer coefficient in laminar flow. The simple flat plate equation is shown to underestimate the heat-transfer

coefficient, whereas the method of Cohen and Reshotko predicts coefficients that are too large. The incremental flat plate method of Pasqua and Stevens and a modification of a solution of Beckwith and Cohen exhibit good results downstream of the nozzle throat when referenced to the value calculated by the simple flat plate equation at the nozzle exit. The effects of thermal radiation upstream of the nozzle throat are indicated. Author

N64-18637 Canadian Armament Research and Development Establishment, Valcartier

ESTIMATES OF SURFACE TEMPERATURES ON THE SHELLS OF HOLLOW SPHERES PROJECTED AT HYPERSONIC VELOCITY

D. Heckman Feb. 1964 17 p refs
(ARPA Order 133)
(CARDE-TN-1607)

Exterior and interior surface temperatures versus time histories are calculated at the stagnation point for hollow 1-in.-diam metallic spheres projected in air at velocities of 16,000 f.p.s. Author

N64-18757 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONCERNING THE INFLUENCE OF RADIATION HEAT EXCHANGE ON THE REMOVAL OF SUBSTANCE IN THE CRITICAL POINT OF BLUNT-NOSED BODY

V. Ya. Neyland 15 Jul. 1963 13 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 2, no. 4, 1962 p 227–231
(FTD-MT-63-60/1+2; AD-434963)

This report discusses: (1) the removal of substance from the surface of a blunt-nosed body blasted by a flow of gas that has a large enthalpy of deceleration; (2) the radiant heat exchange in the environment of the critical point of a blunt-nosed body that appears because of the radiation of the gas of a shock-wave heated incoming flow (the radiation proceeding from the surface of the body to the boundary layer); (3) the dependence of the total flow of heat to the surface on the expenditure of material if the incoming material from the wall to the boundary layer radiates and absorbs radiant flows; and (4) the radiant flow of heat entering through the external boundary of the boundary layer when this flow is considered to be fixed. I.v.L.

N64-18791 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.

NATURAL CONVECTION HEAT TRANSFER COEFFICIENTS FOR LIQUID METALS AT HIGH HEAT FLUXES

Akbar F. Brinsmade and Leland G. Desmon Feb. 1964 37 p refs Presented at the 56th AICHE Ann. Meeting, Liquid Metal Working Fluids for Space Power Appl. Session, Houston, 1–5 Dec. 1963
(ABL/Z-69; AD-434936)

Natural convection liquid-metal heat-transfer measurements were made in a rocket nozzle containing refractory-metal calorimetric devices utilizing lithium, sodium, and tin as heat-transfer agents. Test variables included propellant-gas throat-stagnation temperatures in excess of 6000° F, accelerations up to 14.3 g, and heat fluxes to 1.7×10^6 Btu/hr × ft^2. Test data and natural convection correlations are presented. Author

N64-18801 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency

PROCEEDINGS OF THE FIRST MEETING OF THE INTER-AGENCY CHEMICAL ROCKET PROPULSION GROUP, WORKING GROUP ON THERMOCHEMISTRY, NEW YORK, NOVEMBER 5-7, 1963, VOLUME 1

Feb. 1964 252 p refs
(Contract NOw-62-0604-c)
(CPIA-44, Vol. 1; AD-435000)

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1. RECENT MICROWAVE SPECTRA STUDIES OF HIGH TEMPERATURE SPECIES D. R. Lide, Jr. (NBS) p 1–2 refs (See N64-18802 11-07)

2. APPLICATION OF THE TECHNIQUE OF MATRIX ISOLATION TO THE STUDY OF THE INFRARED SPECTRA AND THE STRUCTURES OF INORGANIC MOLECULES STABLE AT ELEVATED TEMPERATURES D. White (Ohio State U.) p 3–10 refs (See N64-18803 11-07)

3. SOME RECENT INFRARED SPECTRA OF THORIA, ZIRCONIA AND HAFNIA BY MATRIX ISOLATION M. J. Linevsky (GE Co.) p 11–20 refs (See N64-18804 11-07)

4. INFRARED SPECTRA BY MATRIX ISOLATION OF SOME LOW-MOLECULAR-WEIGHT INORGANIC COMPOUNDS A. Snelson (IIT Res. Inst.) p 21–26 refs (See N64-18805 11-07)

5. THERMODYNAMIC PROPERTIES OF VAPORIZING MOLECULES W. Weltner, Jr. (Union Carbide Res. Inst.) p 27–30 refs (See N64-18806 11-13)

6. ULTRAVIOLET SPECTROSCOPY K. K. Innes (Vanderbilt U.) p 31–33 (See N64-18807 11-07)

7. X-RAY STUDY OF 1-ETHYLDECABORANE A. Perloff (NBS) p 35–41 refs (See N64-18808 11-07)

8. THERMOCHEMISTRY OF THE NOBLE GAS FLUORIDES W. V. Johnston (N. Amer. Aviation, Inc.) p 43–48 refs (See N64-18809 11-13)

9. THERMODYNAMIC STUDIES ON SUBSTANCES OF INTEREST IN A LIGHT ELEMENT PROGRAM, PART I, INORGANIC COMPOUNDS G. T. Armstrong (NBS) p 49–80 refs (See N64-18810 11-13)

10. SURVEY OF THERMODYNAMIC DATA FOR BERYLLIUM SPECIES D. L. Hildenbrand (Aeronutronic) p 81–86 refs (See N64-18811 11-13)

11. RECENT STUDIES OF THERMODYNAMIC PROPERTIES OF BERYLLIUM SPECIES T. B. Douglas (NBS) p 87–99 refs (See N64-18812 11-13)

12. THE THERMODYNAMIC PROPERTIES OF SOME BERYLLIUM COMPOUNDS M. A. Greenbaum, M. Farber et al (Rocket Power, Inc.) p 101–104 refs (See N64-18813 11-13)

13. RECENT WORK AT ARTHUR D. LITTLE A. Buchler (Little (Arthur D.) Inc.) p 105–119 refs (See N64-18814 11-13)

14. A NOTE ON THE FRAGMENTATION PATTERN OF LiF J. Berkowitz (Argonne Natl. Lab.) p 121–122 refs (See N64-18815 11-07)

15. MASS SPECTROMETRIC SAMPLING OF FLAMES T. A. Milne, J. Brewer, and F. T. Greene (Midwest Res. Inst.) p 123–138 refs (See N64-18816 11-26)

16. THERMOCHEMISTRY OF BORON AND SOME OF ITS COMPOUNDS. THE HEATS OF FORMATION OF TRIMETHYLAMINEBORANE AND ORTHOBORIC ACID W. D. Good, J. P. Mc Cullough (Bur. of Mines), and M. Mansson (Lund U., Sweden) p 139–147 refs (See N64-18817 11-13)

17. EXPERIMENTAL EVALUATION OF THE HEATS OF FORMATION OF BORON-CONTAINING COMPOUNDS J. D. Rockenfeller (United Aircraft) p 149–159 refs (See N64-18818 11-13)

18. THERMODYNAMIC STUDIES OF MIXED-METAL

COMPOUNDS D. L. Hildenbrand, W. F. Hall, N. D. Potter and L. P. Theard (Aeronutronics) p 161–162 refs (See N64-18819 11-13)

19. RESEARCH ON THE THERMODYNAMICS OF THE A1-B-O, Be-B-O and Li-B-O SYSTEMS P. E. Blackburn (Little (Arthur D.), Inc.) p 163–171 refs (See N64-18820 11-13)

20. A SURVEY OF CERTAIN THERMODYNAMIC DATA ON SOME LIGHT-ELEMENT MIXED-METAL AND MIXED-NONMETAL COMPOUNDS T. B. Douglas (NBS) p 173–182 refs (See N64-18821 11-13)

21. THE THERMODYNAMIC PROPERTIES OF SOME OXYHALIDES OF THE LIGHT ELEMENTS M. A. Greenbaum, M. Farber et al (Rocket Power, Inc.) p 183–185 (See N64-18822 11-13)

22. A REVIEW OF DATA ON HEAVY METAL REFRACTORY COMPOUNDS H. L. Schick (Avco Corp.) p 187–212 refs (See N64-18823 11-19)

23. THERMODYNAMIC STUDIES AT LOW AND HIGH TEMPERATURES R. A. Mc Donald, F. L. Oetting, and H. Prophet (Dow Chem. Co.) p 213–245 refs (See N64-18824 11-13)

N64-18806 Union Carbide Research Inst., Tarrytown, N.Y.
THERMODYNAMIC PROPERTIES OF VAPORIZING MOLECULES
William Weltner, Jr. *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 27–30 refs (See N64-18801 11-13)
(Contract DA-30-069-ORD-2787)

The thermodynamics of vaporization of some high-temperature materials is considered in the light of recent spectroscopic studies. The spectra of the vaporizing molecules were measured after trapping them in a solid inert gas at 4° or 20° K, i.e., the experiments utilized the matrix-isolation technique. The following materials were studied: boric oxide, carbon, silicon carbide, tantalum oxide, tungsten oxide, lanthanum carbide, and boron carbide. Author

N64-18809 North American Aviation, Inc., Canoga Park, Calif. Science Center
THERMOCHEMISTRY OF THE NOBLE GAS FLUORIDES
William V. Johnston *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 43–48 refs (See N64-18801 11-13)

Thermochemical data have thus far been obtained only for XeF_2, XeF_4, XeF_6, and XeO_3. In most instances the purity of material has been less than is usually desired for definitive thermochemical data, but nevertheless has been sufficient for determining bond energies, tests of the third law of thermodynamics, or of the correctness of some of the theoretical approaches. Author

N64-18810 National Bureau of Standards, Washington, D.C. Heat Div.
THERMODYNAMIC STUDIES ON SUBSTANCES OF INTEREST IN A LIGHT ELEMENT PROGRAM. PART I. INORGANIC COMPOUNDS
George T. Armstrong *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 49–80 refs (See N64-18801 11-13)
(ARPA Order 20)

The discussion of thermodynamic studies is divided into the following areas: (1) a survey of the thermodynamic data of fluorine compounds—a discussion of the completeness of existing thermodynamic data and of the state of the thermodynamic data on selected compounds (hydrogen fluoride, beryllium fluoride, aluminum fluoride, and aluminum fluoride hydrates); (2) recent studies of the thermodynamic data of beryllium species—a discussion of the experimental combustion of beryllium in fluorine and the energy state of BeF_2 (solid); and (3) recent studies on refractory compounds—a review of existing thermodynamic data on the metallic borides (heat of combustion of aluminum carbide and aluminum boride, crystal form of aluminum oxide combustion product, heat of formation of Al_4C_3). P.V.E.

N64-18811 Aeronutronic, Newport Beach, Calif.
SURVEY OF THERMODYNAMIC DATA FOR BERYLLIUM SPECIES
D. L. Hildenbrand *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 81–86 refs (See N64-18801 11-13)
(Supported by ARPA)

The available thermodynamic data for beryllium species (Be-O, Be-O-H, Be-F, and Be-Cl species) that are of interest in advanced propellant applications are summarized. In particular, the following data are presented in tabular form: (1) heats of formation and bond energies of Be-O and Be-O-H vapor species; (2) entropy data for gaseous dihalides; and (3) heats of formation and bond energies of beryllium halides. P.V.E.

N64-18812 National Bureau of Standards, Washington, D.C.
RECENT STUDIES OF THERMODYNAMIC PROPERTIES OF BERYLLIUM SPECIES
Thomas B. Douglas *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 87–99 refs (See N64-18801 11-13)

The heat capacity of a crystalline sample of BeF_2 from 7° to 300° K was measured by adiabatic calorimetry, and the relative enthalpy from 273° to approximately 1,200° K was measured by drop calorimetry. A number of qualitative and quantitative mass-spectrometric studies were carried out on the BeF_2, the $BeO\text{-}BeF_2$, $BeOAl_2O$, and $BeO\text{-}Al_2O_3$ systems. Methods for determining the physical properties of the various polymorphic forms of BeF_2 are discussed. P.V.E.

N64-18813 Rocket Power Inc., Pasadena, Calif.
THE THERMODYNAMIC PROPERTIES OF SOME BERYLLIUM COMPOUNDS
Michael A. Greenbaum, Milton Farber et al *In* JPL Proc. of The 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 101–104 (See N64-18801 11-13)

The thermodynamic properties were determined by means of transpiration studies, torsion and gravimetric effusion, and molecular-flow reactions. Beryllium compounds studied include the following: (1) BeO—determination of the heat capacity between 2,273° and 2,573° K and heat of fusion of beryllium oxide; (2) $BeCl_2$—determination of the vapor-pressure curve of solid beryllium chloride over the temperature range 440° to 600° K; (3) BeCl—the reaction $BeCl_2(g) + Be(l) \rightarrow 2BeCl(g)$ was studied over the temperature range 1,573° to 1,723° K; (4) BeF_2—establishment of the vapor-pressure curve for liquid beryllium fluoride over the 823° to 1,223° K temperature range; (5) BeF—study over the temperature range of 1,425° to 1,675° K of the reaction $BeF_2(g) + Be(s,l) \rightarrow 2BeF(g)$; (6) Be_3N_2—the decomposition pressure of solid beryllium nitride according to the equation $Be_3N_2(s) \rightarrow 3Be(g) + N_2(g)$ was measured between 1,400° and 1,700° K; and (7) MgF_2—measurement of the vapor pressure between 1,273° and 1,513° K. P.V.E.

N64-18814 Little (Arthur D.) Inc., Cambridge, Mass.
RECENT WORK AT ARTHUR D. LITTLE
Alfred Büchler *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 105–119 refs (See N64-18801 11-13)

Mass-spectrometric determination of the heats of sublimation of lithium fluorides (LiF, Li_2F_2, and Li_3F_3) is discussed. Some problems connected with the mass spectrometric analysis of mixed systems (in particular Li-F and Li-Be-F systems) are discussed along with the usefulness of electrochemical experiments (e.m.f. measurement) as sources of thermodynamic data. An electric quadrupole field was used in conjunction with the nuclide high-temperature mass spectrometer to determine whether high-temperature species effusing from a molecular-beam oven are polar or not, and in this way obtain structural information concerning these species. Typical electric quadrupole deflection experimental data for lithium fluoride and lithium chloride systems are summarized along with data obtained for various metal–group II halide systems, aluminum–fluoride systems, and boron–oxygen systems. P.V.E.

N64-18817 Bureau of Mines, Bartlesville, Okla. Thermodynamics Lab.
THERMOCHEMISTRY OF BORON AND SOME OF ITS COMPOUNDS. THE HEATS OF FORMATION OF TRIMETHYLAMINEBORANE AND ORTHOBORIC ACID
W. D. Good, J. P. Mc Cullough, and M. Mansson (Lund U., Sweden) *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 139–147 refs (See N64-18801 11-13)
(Contract CSO-59-9; ARPA Order 24-59)

A rotating-bomb calorimetric technique was developed to solve the problem of determining the heats of combustion of organic boron compounds. The heats of combustion of crystalline boron and trimethylamineborane, $(CH_3)_3NBH_3$, were determined. The combustion product was a solution of fluoboric acid in excess aqueous HF. The standard heat of formation, $\Delta H_{f^\circ 298.15}$, of trimethylamineborane (c,III) is -34.04 ± 0.55 kcal mole^{-1}. The heat of solution of orthoboric acid in HF solution chosen to yield the same fluoboric acid solution was determined. The heat of formation of orthoboric acid was calculated; $\Delta H_{f^\circ 298.15}(H_3BO_3,c) = -261.47 \pm 0.20$ kcal mole^{-1}. Combination of these results with data from the literature permitted calculation of the heats of formation of B_2O_3 and B_2H_6 referred directly to crystalline boron. Author

N64-18818 United Aircraft Corp., East Hartford, Conn.
EXPERIMENTAL EVALUATION OF THE HEATS OF FORMATION OF BORON-CONTAINING COMPOUNDS
J. D. Rockenfeller *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 149–159 refs (See N64-18801 11-13)

A description is presented of experimental apparatus in which heats of formation measurements are made. Experimental techniques for determining reliable values of heats of formation of B-H-C-N compounds are discussed, and a preliminary value for the heat of formation of hydrazine monoborane (HMB) is presented ($\Delta H = -8 \pm 2$ kcal/mole). P.V.E.

N64-18819 Aeronutronic, Newport Beach, Calif.
THERMODYNAMIC STUDIES OF MIXED-METAL COMPOUNDS
D. L. Hildenbrand, W. F. Hall, N. D. Potter, and L. P. Theard *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 161–162 refs (See N64-18801 11-13)
(Supported by ARPA)

A brief summary of thermodynamic studies carried out on the following compounds is presented: (1) Li_2O-B_2O_3 system—measurement of the vapor pressure of liquid $LiBO_2$ over the temperature range 1,120° to 1,280° K; (2) LiF-AlF_3 system—sublimation behavior of compositions ranging from 25 to 67 mole % AlF_3; (3) Li_2O-Al_2O_3 system—vaporization behavior of $LiAlO_2$(c) in the range 1,610° to 1,840° K; (4) B_2O_3-Al_2O_3 system—vaporization studies on various compositions of the system; and (5) LiF-BF_3 system—mass spectrometric studies of the system vapors. P.V.E.

N64-18820 Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THE THERMODYNAMICS OF THE Al-B-O, Be-B-O AND Li-B-O SYSTEMS
Paul E. Blackburn *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 163–171 refs (See N64-18801 11-13)

Vapor pressures over mixed oxide systems are measured isothermally as a function of composition. These measurements are used to provide thermodynamic values for the vapor species and the condensed phases. A description is presented of the apparatus used in the investigations, and a brief discussion is given of the results. Two isothermal experiments were carried out on a Be-B-O system, starting with the initial composition of $3B_2O_3$-BeO. From the results obtained at 1,459° K, a logarithm of the B_2O_3 activity was plotted against the condensed phase composition. A broad two-phase region, characterized by a constant pressure with changing composition, was found extending to about 50 mole % BeO. This was followed by a decrease in activity to about 80 mole % BeO. The second measurement at 1,350° K shows a wider two-phase region extending to 70 mole % BeO, with a sharp decrease in activity to 75 mole % BeO. P.V.E.

N64-18821 National Bureau of Standards, Washington, D.C.
A SURVEY OF CERTAIN THERMODYNAMIC DATA ON SOME LIGHT-ELEMENT MIXED-METAL AND MIXED-NONMETAL COMPOUNDS
Thomas B. Douglas *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 173–182 refs (See N64-18801 11-13)

Discussed is the present status of measurements on: (1) the condensed-phase heat capacities (and heats of fusion and transition) of light-element mixed-metal compounds; and (2) solid-vapor equilibria of AlF_3-containing systems, and the thermodynamic properties of mixed halides of aluminum. P.V.E.

N64-18822 Rocket Power, Inc., Pasadena, Calif.
THE THERMODYNAMIC PROPERTIES OF SOME OXYHALIDES OF THE LIGHT ELEMENTS
Michael A. Greenbaum, Milton Farber, et al *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 183–185 (See N64-18801 11-13)

The reaction $B_2O_3(s,l) + BF_3(g) \rightarrow (BOF)_3(g)$ was studied between 330° and 1,000° K, and the experimental data yielded a value of -566.1 ± 2.0 kcal/mole for ΔH_f^{298} of $(BOF)_3(g)$.

Thermodynamic data for the gaseous monomer of boron oxyfluoride obtained by studying the reaction $B_2O_3(l) + BF_3(g) \rightarrow 3BOF(g)$ resulted in a value of -144 ± 6 kcal/mole for the $\Delta H_f^{298°K}$ of BOF(g) and a value of 53 ±4 cal/deg/mole for $S^0_{298°K}$. The reaction $B_2O_3(l) + BCl_3(g) \rightarrow (BOCl)_3(g)$ produced the following values for $\Delta H_f^{298°K}$ and $S^0_{298°K}$, respectively, -396.7 ± 2.0 kcal/mole and 92.5 ± 2.0 cal/deg/mole for $(BOCl)_3(g)$. Data from the reaction $1/3B_2O_3(l) + 1/3BCl_3(g) \rightarrow BOCl(g)$ resulted in values of -74.8 ± 7.0 kcal/mole and 57.8 ± 5.0 cal/deg/mole for the $\Delta H_f^{298°K}$ and $S^0_{298°K}$ of BOCl(g). A study of the reaction $Al_2O_3(s) + AlF_3(g) \rightarrow 3AlOF(g)$ at 2,200° K gave a value of -139.2 ± 2.4 kcal/mole for $\Delta H_f^{298°K}$ for AlOF(g). Data obtained for the reaction $1/3Al_2O_3(l) + 1/3AlCl_3(g) \rightarrow AlOCl(g)$ indicated a value for $\Delta H_f^{298°K}$ of -82.0 ± 3.0 kcal/mole for AlOCl(g). P.V.E.

N64-18824 Dow Chemical Co., Midland, Mich. Thermal Research Lab.

THERMODYNAMIC STUDIES AT LOW AND HIGH TEMPERATURES

R. A. Mc Donald, F. L. Oetting, and H. Prophet *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 213–245 refs (See N64-18801 11-13)

Heat capacity curves for the following materials are presented along with a discussion of methods used in obtaining the data: lithium chloride and phosphorus pentoxide (both up to 320° K); boron and boron nitride (both up to 1,700° K); ZrF_4 (between 300 and 1,200° K); aluminum chloride (up to 500° K); boron phosphate and lithium metaborate (both up to 1,200° K); beta beryllium chloride (up to 700° K); aluminum oxide (between 500 and 2,000° K); beryllium oxide, titanium nitride, titanium diboride, zirconium diboride, and zirconium carbide (all up to 2,200° K); boron nitride (between 500 and 2,300° K); titanium diboride, tungsten monoboride, and ditungsten pentaboride (all between 300 and 2,200° K); and tantalum carbide, niobium carbide, hafnium carbide, and tungsten carbide (all between 1,000 and 2,200° K). P.V.E.

N64-18849 Army Cold Regions Research and Engineering Lab., Hanover, N.H.

LAMINAR HEAT TRANSFER OVER A MELTING PLATE – THE MODIFIED LEVEQUE PROBLEM

Yin-Chao Yen and Chi Tien Jan. 1964 23 p refs
(CRREL Res. Rept. 125; AD-435609)

The temperature distribution in a fluid flowing over a melting plate and having a linear tangential velocity profile is determined theoretically. Melting at the interface is shown to result in a decrease in the Nusselt number. Consideration is given to the practical application of the results. A simple numerical calculation is also given. Author

N64-18867 Stanford Research Inst., Menlo Park, Calif.

FLUID FRICTION AND BOILING HEAT TRANSFER WITH WATER IN VORTEX FLOW IN TUBES CONTAINING AN INTERNAL TWISTED TAPE Final Report

Lester Feinstein and R. E. Lundberg Jun. 1963 84 p refs
(Contract AF 30(602)-2760/RALTP)
(RADC-TDR-63-451; AD-430889)

The problems of fluid friction and boiling heat transfer from a tube to water in vortex flow are considered. The vortex is promoted and maintained by an internal twisted ribbon. Twist ratios, Y, of 2, 4, and 6 are utilized. Friction factors are measured for straight flow and vortex flow for Reynolds numbers from 60,000 to 400,000. Burnout heat flux, ϕ_{bo}, is measured as a function of flow velocity and for two different values of fluid subcooling, both in straight flow and in vortex flow. The maximum heat flux attained was 28×10^6 Btu/hr-ft^2 (900 w/cm^2). The burnout flux measured for vortex flow is substantially lower than previously reported values. This difference is rationalized and an approximate theory developed to quantify the experimental values. A comparison between maximum operating heat fluxes obtainable in straight flow and vortex flow is made on the basis of pumping power. Author

N64-18921 General Dynamics/Fort Worth, Tex. Engineering Dept.

A RADIATIVE INSULATION SYSTEM FOR STRUCTURAL PROTECTION IN A RE-ENTRY ENVIRONMENT

A. D. Mayfield, M. H. Kite, and C. F. Herndon 15 Apr. 1964 50 p refs
(Contract AF 33(657)-11214)
(ERR-FW-120; AD-436266)

The research project's purpose was to design, fabricate, and test a practical and thermally efficient insulating system. Such a system has been evolved through an intensive literature search, a careful examination of the design criteria, and an evaluation of the high-temperature materials currently available. The system weighs about 1.2 lb/ft^2, is only 1-in. thick, and is unique in integrating available materials into a composite configuration both thermally efficient and light in weight. Another unique feature is its use of a nonmetallic material of low thermal conductivity—a ceramic pin—as a means of attaching the various components of the insulation system. Author

N64-18945 General Dynamics/Fort Worth, Tex. Engineering Dept.

HEAT TRANSFER IN HONEYCOMB SANDWICH PANELS

J. V. Clifton 15 Apr. 1964 51 p
(Contract AF 33(657)-11214)
(ERR-FW-104; AD-436322)

An analytical method for predicting the heat transfer in honeycomb sandwich panels, including the conduction of heat in the cell due to radiation, has been developed and is presented. Excellent agreement has been obtained between the analytical predictions and experimental measurements of transient heat transfer in both brazed and bonded sandwich panels. An analytical method is also presented for predicting the effective thermal conductivity of honeycomb cores, for conditions of steady-state heat transfer through the core. Author

N64-18962* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

EXPERIMENTAL LOCAL HEAT-TRANSFER AND AVERAGE FRICTION DATA FOR HYDROGEN AND HELIUM FLOWING IN A TUBE AT SURFACE TEMPERATURES UP TO 5600°R

Maynard F. Taylor Washington, NASA, Apr. 1964 35 p refs
(NASA TN D-2280) OTS: $1.00

Local values of heat-transfer coefficients and average friction coefficients were measured experimentally for helium and hydrogen gases flowing through an electrically heated tungsten tube with a length-to-diameter ratio of 77 for the following range of conditions: local surface temperatures up to 5,600°R, local Reynolds number from 7,600 to 39,500, local ratios of surface to bulk gas temperature up to 5.6, and heat flux up to 1,700,000 Btu/hr/ft^2. A comparison of local heat-transfer coefficients for helium and hydrogen gases is made for several types of wall temperature distributions in order to determine whether data can be correlated by a Dittus–Boelter type equation. Author

N64-19006 European Atomic Energy Community, Brussels (Belgium)

THERMAL CONDUCTIVITY OF SOME POLYPHENYLS AND MIXTURES THEREOF [WARMELEITFAHIGKEIT EINIGER POLYPHENYLE UND POLYPHENYLMISCHUNGEN]

F. W. Reiter Joint Nuclear Res. Center, Ispra Establishment (Italy), Heat Exchanges Service, Feb. 1964 31 p refs In GERMAN; ENGLISH abstract

(EUR 582.d) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 50 Belg. Fr.

The thermal conductivity of some organic liquids that are important as reactor coolants was determined in a stationary hot wire cell. The substances were diphenyl, o-, m-, p-terphenyl, Dowtherm A, and OM_2, a terphenyl mixture. The measurements were made from the melting point up to about 50° C below the normal boiling point. The error is estimated to be less than 2%. Author

N64-19028 Lockheed Missiles and Space Co., Sunnyvale, Calif. Flight Technology Div.

THEORY FOR THE THERMOPHYSICAL PERFORMANCE OF CHARRING ORGANIC HEAT-SHIELD COMPOSITES

K. M. Kratsch, L. F. Hearne, and H. R. Mc Chesney 18 Oct. 1963 91 p refs

(Rept. 2-60-63-7; LMSC-803099)

A theoretical thermochemical performance analysis is given for those organic polymeric composites that decompose in depth, leaving a residual carbonaceous char. Each energy-absorption mechanism active during decomposition is mathematically formulated, i.e., a description of the individual depolymerization kinetics of a two-component resin-fabric composite. Mass transfer and combustion effects are coupled to the incident aerodynamic environment at the heated surface. A continuous dependence of surface recession on temperature and pressure is theoretically demonstrated. Both transient and quasi-steady solutions are present. The thermophysical and chemical kinetic coefficients required to implement the theory are given for a 1:1 weight-ratio nylon-reinforced phenolic composite. These properties are transformed through application of the theory to effect correlation of air-arc test data and in-flight data obtained in the Thor–Able RVX-1 flight-test series. The thermal performance of nylon-phenolic can be predicted with an accuracy comparable to that of defining the aerodynamic heating environment. Author

N64-19039 Training Center for Experimental Aerodynamics Rhode-Saint-Genèse (Belgium)

EFFECT OF A STEPWISE DISTRIBUTION OF HEAT TRANSFER ON THE SUPERSONIC FLOW OVER A FLAT PLATE

W. J. Mc Croskey Jun. 1963 71 p refs

(TCEA-TN-13)

The effect of a stepwise distribution of heat transfer on a flat plate has been studied by considering the ratio of the heat-transfer coefficients h_q for a step in heat flux to the heat-transfer coefficient h for a uniformly heated plate. The ratio h/h_q is a simple function of the ratio of the distance x along the plate to the length ℓ of the unheated portion, independent of Mach, Reynolds, and Prandtl numbers. The theoretical predictions were verified experimentally in air at a Mach number of 2 for various Reynolds numbers and values of x/ℓ. Author

N64-19072 Weapons Research Establishment, Australia

A METHOD OF CALCULATING SURFACE TEMPERATURES OF WALLS SUBJECTED TO AERODYNAMIC HEATING WITH HEAT TRANSFER COEFFICIENT AND ADIABATIC WALL TEMPERATURE DESCRIBED

G. Jepps and A. R. Glasson Dec. 1963 27 p refs

(WRE-TN-HSA-95)

An integral equation method is given for calculating the temperature at the surface of a plane wall subjected to aerodynamic heat transfer, when the other surface is insulated. All heat conduction is assumed to be in a direction normal to the wall surface. Heat-transfer coefficients and adiabatic wall temperatures are functions of time, prescribed either analytically or graphically; heat-transfer coefficients can also be dependent on surface temperature. The proposed method will generate analytic expressions for surface temperature from analytic expressions for adiabatic wall temperature and heat-transfer coefficient and can, therefore, have applications to vehicle insulation design studies. In comparison with Hill's numerical method, the proposed method has the advantage that the accuracy of the solution can be assessed as the computation proceeds and that it can deal with rapidly changing surface temperatures. Some examples of the use of the method are given. Author

N64-19073 University of Southern Calif. Engineering Center, Los Angeles

WIND TUNNEL TESTS AT SUPERSONIC MACH NUMBERS TO DETERMINE HEAT-TRANSFER COEFFICIENTS IN THE SHOCK WAVE-BOUNDARY LAYER INTERACTION REGION ON A PLANE SURFACE

Lawrence R. Kelley 27 Dec. 1962 31 p refs

(Contract NOW-61-0679-c)

(USCEC 65-41; AD-432218)

The overall objective of this wind-tunnel test program was to provide experimentally determined heat-transfer coefficients on a flat-plate model and the corresponding test condition data. Thus, a correlation could be found between the heat-transfer coefficients in the shock-wave boundary-layer interaction zone and such measurable or computable quantities as the "effective" Reynolds number, the free-stream Mach number, and the strength of the wave. The shock wave was generated by an auxiliary plate placed above the test plate, and the shock strength was varied by changing the angle-of-attack of this "shock-wave-generator plate." The tests were conducted at two Mach numbers, 3.0 and 5.0, in two different wind-tunnel circuits. All of the test objectives were satisfactorily achieved with the exception of obtaining heat-transfer data at Mach 5.0 for different boundary-layer thicknesses. The apparent thickening of the boundary layer that was achieved at Mach 3.0 had no significant effect upon the heat-transfer coefficients. R.T.K.

N64-19100 Itek Corp., Palo Alto, Calif. Vidya Div.

TRANSIENT TEMPERATURE DISTRIBUTION IN ELECTRODES WITH MOVING ARCS

D. C. Briggs Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Feb. 1964 53 p refs

(Contract AF 33(616)-8338)

(ARL 64-32; AD-436766)

An analysis is made of the transient heat-transfer process resulting from the passage of a moving electric arc over an electrode. The analysis follows Rosenthal's initial efforts on moving heat sources. The general equation was expressed in a finite-difference form, and the results were obtained with a digital computer. A description and listing of the program are included. An approximate analysis using an electrical analogy was made, and a rudimentary dimensional analysis correlation is presented. The results of these latter two analyses are useful for electrode temperature predictions. The results of the analyses indicate that, for the typical operating conditions considered, use of relatively thin copper electrodes results in minimum electrode surface temperatures. Author

N64-19131 Lockheed Missiles and Space Co., Sunnyvale, Calif.
AERODYNAMIC HEATING AND OTHER PARAMETERS AFFECTING SPACE VEHICLE OPERATIONS: AN ANNOTATED BIBLIOGRAPHY
Charles G. Gros, comp. Feb. 1963 49 p 80 refs
(Contract AF 04(647)-673)
(Rept. 3-35-63-2; SB-63-18; AD-436090)

The abstracts are arranged alphabetically by author. Corporate author, personal author, and subject indexes are included. The period covered, with one earlier exception, is from 1959 through 1962. Material dealing with aerodynamic heating as an isolated phenomenon has not been included. Author

N64-19179 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBLEMS OF HEAT TRANSFER IN RAREFIED GASES
L. Ye. Kalikhman 18 Jun. 1963 4 p Transl. into ENGLISH from Soveshch. po Teplo i Massoobmenu (Minsk) 1961 p 31–32
(FTD-TT-62-978/1+4; AD-414835)

Convective heat transfer in rarefied gases is considered. The problem of determining heat-transfer coefficients is discussed. The problem of heat transfer of a longitudinally streamlined flat plate was solved by two methods: the method of linearization of equations and the method of series expansion. R.T.K.

N64-19214 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE QUESTION OF HEAT AND MASS TRANSFER AT THE FORWARD POINT OF BLUNT BODIES IN THE PRESENCE OF HETEROGENEOUS CHEMICAL REACTIONS
V. P. Motulevich 3 May 1963 17 p refs Transl. into ENGLISH from Inzh. Fiz. Zh. Akad. Nauk Belorusskoi SSR (Minsk), v. 4, no. 11, 1961 p 10–18
(FTD-TT-63-310/1+2+4; AD-407942)

Considered is the heat and mass transfer of a blunt body in an incompressible fluid flow in the presence of heterogeneous reactions of the most general type occurring at finite rate. Analyzed are the questions of ignition and extinction, as well as the dependence of the intensity of mass removal and surface temperature on the various parameters characterizing the body, the flow, and the chemical reactions. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-18581 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Labs.
NONLINEAR OSCILLATIONS AND ELECTROENCEPHALOGRAPHY
Edmond M. Dewan Aug. 1963 23 p refs
(AFCRL-63-364; AD-421980)

It has been found that almost all of the well-known phenomena of nonlinear oscillations have counterparts in the macroscopic neuroelectric behavior of the human brain. Examples of such correspondences are: (1) soft limit cycles—"spontaneous" oscillatory brain activity; (2) hard limit cycles involving inertial nonlinearities—initiation of epileptic after-discharges by local electrical stimulation of the cortex; (3) nonlinear entrainment—hypersynchrony, photic driving of brain rhythms; (4) oscillation hysteresis—paradoxical duration of certain after-discharges; (5) variation of the parameter μ in van der Pol's equation $\ddot{x} - \mu(1 - x^2)\dot{x} + x = 0$—evolution of epileptic after-discharge from high-frequency waves into low-frequency relaxation oscillations and a connection between exhaustion and epileptic foci; and (6) asynchronous actions—blocking of the "alpha rhythm," "facilitation" and excitation and suppression activity associated with attention. These correspondences permit the construction of a very suggestive phenomenological theory to explain electroencephalographic data in terms of nonlinear stability, which in turn reveals unsuspected relationships in the data and suggests new experiments. Author

N64-18588 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
SIGNAL DETECTION BY HUMAN OBSERVERS Final Report
John A. Swets and David M. Green Bedford, Mass., Electron. Systems Div., Oct. 1963 49 p refs
(Contract AF 19(604)-1728; Contract AF 19(604)-7459)
(ESD-TDR-64-174; AD-434825)

Theoretical and experimental studies of tasks in which the detection response was based on a sequence of observations, rather than on a single observer's response, were conducted. The application of decision theory permits separation of the effects of variation in the observer's response criterion from those of variation in his sensitivity. It was demonstrated that the sensitivity index of the theory is invariant over several different psychophysical procedures. It was also demonstrated that the effects of practice on sensitivity are small and of short duration, and that the effect on sensitivity of attempts to vary motivation is practically nonexistent. By an examination of the consistency of the observer's detection responses to the same signal, the relative importance of external and internal determinants of the response was determined. Much of the research effort was devoted to the problem of frequency analysis, or pitch perception. Investigations were also made of color vision, of the effects of signal uncertainty, of intensity discrimination, and of internally generated noise. Abstracts are included of the papers that have been published as a result of these investigations. R.T.K.

N64-18599 Aerospace Medical Div. Aerospace Medical Research Labs (6570th), Wright-Patterson AFB, Ohio
ESTIMATING MANNING REQUIREMENTS FOR ADVANCED SYSTEMS: A SURVEY OF THE DEFENSE INDUSTRY
Donald B. Haines and Sidney Gael Nov. 1963 31 p refs
(AMRL-TDR-63-110; AD-432483) OTS: $1.00

The survey was part of a long-range program of research aimed at the identification and quantification of manning requirements for advanced weapon systems. A five item, open-ended questionnaire was sent to human-factors specialists in key defense industries. Five different approaches to estimating manning were reported; the most popular was the use of task analysis or some combination of task analysis with variations of the other approaches. Other methods were: expert estimation, historical comparison, sovereign factors, and mathematical models. The most frequently cited guides were USAF publications, but a wide variety of other texts, handbooks, and technical publications were also reported. Respondent experience ranged over the major weapon systems, subsystems, and control networks. The report concludes with suggestions for the characteristics of a method acceptable to industry. Author

N64-18734* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE ADAPTIVE DYNAMIC RESPONSE CHARACTERISTICS OF THE HUMAN OPERATOR IN SIMPLE MANUAL CONTROL
Laurence R. Young, David M. Green, Jerome I. Elkind, and Jennifer A. Kelly Washington, NASA, Apr. 1964 104 p refs
(NASA Contract NASw-185)
(NASA TN D-2255) OTS: $2.50

This report describes an experimental investigation of human adaptive control following sudden changes in gain or polarity of the controlled element in a closed-loop tracking task. The experiments used primarily simple position control to determine lower bounds on the adaptation process. Random inputs were tracked under pursuit and compensatory single-axis displays. Times necessary for adaptation to changes in simple tracking conditions are quite small. Human operator control adaptation generally occurs in 0.4 to 0.8 sec following a controlled element change, and the resulting error is usually reduced to its asymptotic level in 1 to 3 sec following transition. Author

N64-18785 Texas Christian U., Fort Worth, Tex.
PREDICTION OF AIR FORCE ADAPTABILITY OF BASIC AIRMEN REFERRED FOR PSYCHIATRIC EVALUATION
S. B. Sells Lackland AFB, Tex., Personnel Res. Lab. (6570th), Sep. 1963 67 p refs
(Contract AF 41(657)-4111)
(PRL-TDR-63-23; AD-426768)

Data from enlistment records, basic training, and clinic referral were collected and analyzed to identify predictors of success within the psychiatric referral group. Keying 24 items from clinical records resulted in scores that correlated 0.55 with the criterion of Air Force success. Regression equations were derived to show increased efficiency of prediction from adding the mental hygiene data to other predictors of success. Distributions of the mental hygiene scores illustrate possible use of a cutting score for early identification of mental hygiene referrals not likely to successfully complete an Air Force tour. Author

N64-18796 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE HUMAN OPERATOR AS A MONITOR AND CONTROLLER OF MULTI-DEGREE OF FREEDOM SYSTEMS
John W. Senders [1963] 27 p refs Presented at the 4th Natl. Symp. on Human Factors in Electronics, IEEE Men, Machines, and Systems, Wash., D.C. 2–3 May 1963

This report sets forth a model that attempts to predict the relation between the kind and rate of information displayed on any display and the frequency and duration of samples made of that display. The approach utilizes the notion that it is possible to quantify the attentional demand or work load placed on the monitor or controller by each source of information in a complex man–machine system. The attentional demand can be calculated on the basis of the bandwidth and required precision of readout of the signal presented by an information source. It can be measured by the frequency and duration of fixations on an information source. The results of theoretical calculations compare favorably with experimental results. Author

N64-18906 Texas Christian U., Fort Worth
PREDICTION OF AIR FORCE ADAPTABILITY OF BASIC AIRMEN REFERRED FOR MENTAL HYGIENE CLINIC EVALUATION Final Technical Report
S. B. Sells and Douglas J. Mace 30 Jun. 1963 74 p refs
(Contract AF 41(657)-4111)
(AD-436571) OTS: $7.60

This report presents the results of an investigation related to the reduction of waste through improvement in the accuracy of performance prediction of Air Force duties of a category of personnel having, as a whole, a poor prognosis for useful service (77% failure). This category consists of airmen in basic training referred by training officers or others for Mental Hygiene Clinic Evaluation as a result of low peer ratings, deviant behavior, or unsatisfactory performance in the basic program. The discussed new key for predicting adaptability was developed, using data-retrieval methods. A 180-item code, sampling 102 objectively recorded and 72 subjective items, was used to analyze data for 4,042 airmen referred for evaluation during basic training. Of these items, 24 (in addition to age and education), which discriminated postbasic pass vs post-basic fail, were selected as the mental hygiene file key. I.v.L.

N64-18937 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE EFFECTS OF TRANSIENT WEIGHTLESSNESS ON BRIGHTNESS DISCRIMINATION Technical Documentary Report, Apr. 1963-Aug. 1963
William J. White Wright-Patterson AFB, Ohio, AMRL, Mar. 1964 21 p refs
(Contract AF 33(657)-11600)
(CAL-VH-B137-E; AMRL-TDR-64-12; AD-435544) OTS: $0.75

Contrast thresholds of six semisupine, visually adapted subjects were obtained under short (10 to 15 sec) periods of weightlessness and under 1-g control conditions. The target, viewed binocularly, subtended 1.5° and the background 2.6°. Three background-luminance levels were used—0.03, 0.28, and 30.0 ft-L. The contrast required to detect the target was slightly, but consistently, lower under the weightless condition than under the 1-g control condition. Under the weightless condition, the contrast required to detect the target averaged 12.56% at 0.03 ft-L background luminance, 6.4% at 0.28 ft-L background luminance, and 3.99% at 30.0 ft-L background luminance. The corresponding contrasts required under the control 1-g condition averaged 15.14%, 7.05%, and 4.45%, respectively. Author

N64-18973 Joint Publications Research Service, Washington, D.C.
MAN PROVES TRAINABLE FOR 100-HOUR ORBITS AND LONGER
V. V. Parin 22 Apr. 1964 6 p Transl. into ENGLISH from Sov. Krasnyy Krest (Moscow), v. 13, no. 2, 1963 p 20–21
(JPRS-24308; OTS-64-31133) OTS: $0.50

The following medical and biological conclusions are drawn on the basis of evidence from the flights of Soviet cosmonauts: A physically healthy man, given the required training, can satisfactorily tolerate weightlessness for a period of 100 hr. The extended experience of weightlessness does not give rise to appreciable variations in the cosmonaut's physiological functions during the diurnal period. These results are felt to indicate that flights lasting for hundreds of hours can be accomplished by cosmonauts who have had the proper training. R.T.K.

N64-19002* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
PILOTING PERFORMANCE DURING THE BOOST OF THE X-15 AIRPLANE TO HIGH ALTITUDE
Euclid C. Holleman Washington, NASA, Apr. 1964 58 p refs
(NASA TN D-2289) OTS: $1.50

During the altitude-buildup program with the X-15 airplane, flights were made in which the boost-climbout phase was similar to the launch of the initial stage of multistage vehicles. The pilot's performance is analyzed in an attempt to more clearly define his capability to control the boost phase of flight. Airplane attitude and overall performance were controlled by the pilot within the accuracy of the displays provided. Although the engine failed to light on the first attempt on two flights and some of the displays failed on several other flights, the pilot was able to successfully complete the flight plans. As a result of physiological factors or extreme motivation, however, on several missions the pilots made corrections they felt were necessary, but which resulted in deviations from the flight plan. The boost acceleration had no effect on the piloting control task, although two of the pilots had difficulty shutting down the engine because of the X-15 throttle location. Author

N64-19101 Radio Corp. of America, Camden, N.J.
A QUEUING MODEL FOR DETERMINING SYSTEM MANNING AND RELATED SUPPORT REQUIREMENTS Technical Documentary Report, Jun. 1962-Dec. 1963
H. R. Barton, R. E. Purvis, J. E. Stuart, and W. K. Mallory Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., Jan. 1964 166 p refs
(Contract AF 33(657)-9439)
(AMRL-TDR-64-21; AD-434803)

The method presented begins with an analysis of hardware functions and develops human requirements in terms of operational needs and service rates. Manning and skill requirements are integrated over such factors as desired operational readiness, schedules of mission frequency, various environmental demands, maintenance concepts and procedures, and training requirements. Two mathematical techniques, queuing theory and linear programing, are used to compute manning requirements and training needs. In practice, failed systems or units pile up in lines waiting for service, or else men are incompletely utilized. Queuing tables permit tradeoffs between men, skill levels, sparing levels, and downtime with given values for operational readiness. The Simplex algorithm permits tradeoffs and optimal determination of training needs for given policies of phaseover and training cost. Author

N64-19213 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WORLD WITHOUT GRAVITY
23 Apr. 1963 6 p Transl. into ENGLISH from the Russian newspaper, Izvestiya, 1 Sep. 1962 4 p
(FTD-TT-63-300/1+4; AD-415642)

The principles behind weightlessness are discussed, and some examples of what will occur in space are given (e.g., the action of a liquid in a glass, boiling water, etc.) P.V.E.

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-18607 Cambridge Systems, Inc., Newton, Mass.
MODIFICATION AND TESTING OF THE TEMPERATURE-HUMIDITY MEASURING SET AN/TMQ-11(A) Final Report
Aug. 1963 67 p refs
(Contract AF 19(628)-410)
(AFCRL-63-595; AD-434792)

This report discusses the engineering design and subsequent modification and testing of the Temperature–Humidity Measuring Set AN/TMQ-11(A), which incorporates a thermoelectric dew point sensing system. All system components and modifications are described in detail. The results of extensive laboratory and field tests for three engineering test models are given. Author

N64-18621 Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
ANALYTIC DESIGN OF IMPROVED STATIC PRESSURE SENSING PROBES FOR ALL MACH NUMBERS
John L. Hess, A. M. O. Smith, and Thomas L. Rivell 14 Feb. 1964 77 p refs
(Contract NOw-62-0297-t)
(LB-31589; AD-435112)

This report describes a systematic analytic method for designing a static-pressure sensing system for an aircraft or a missile. The system relies on a boom-type static-pressure probe that senses free-stream static pressure independently of Mach number, Reynolds number, and flow inclination. Independence of Mach number is obtained by properly shaping the external contour of the probe. Reynolds-number effects are eliminated by the use of a forward orifice location. The sensed pressure is rendered insensitive to flow inclination by distributing pressure orifices around the circumference of the probe. This report is a complete summary of the design method and is intended for use as a design manual for this type of static-pressure sensing system. Author

N64-18647 Oklahoma State U., Stillwater. Research Foundation
DESIGN, DEVELOPMENT, AND CONSTRUCTION OF MICROMETEORITE DETECTION SYSTEMS Final Report
Samuel S. Clapp and Richard F. Buck Dec. 1963 75 p refs
(Contract AF 19(604)-5715)
(AFCRL-64-98; AD-434784)

A historical background is presented to provide an insight into the study of micrometeorite phenomena and the general theory of the acoustic technique for micrometeorite detection. The objectives of the endeavor are discussed along with the environmental conditions that the systems should withstand. The fundamental design concepts are described categorically. The development of the detection system was the result of combining a suitable sensor assembly, an ultrasensitive amplifier, and a digital-to-analog computer, together with a compatible d.c. to d.c. power converter. The evaluation of the prototype production system is described along with the modifications to the preliminary design. Data from three micrometeorite detection systems, which were flown on the satellite 1961α1, were evaluated. The results are tabulated and compared to previous micrometeorite data. Author

N64-18648 Manchester U., Macclesfield (Gt. Brit.)
RESEARCH STUDY AND DEVELOPMENT OF 1-METRE MIRROR TELESCOPE FOR LUNAR AND PLANETARY PHOTOGRAPHY Annual Summary Report No. 3
Zdeněk Kopal Apr. 1963 21 p
(Contract AF 61(052)-400)
(AFCRL-63-949; AD-434769)

Progress in research was reported as follows: (1) optical tests of the 43-in. primary mirror and its associated Cassegrain secondaries at Pic-du-Midi, using the Foucault and interferometric tests; (2) use of the 43-in. telescope in its present shape for monochromatic photography of the Moon through interference filters in the ultraviolet (3,900 A) and the infrared (10,200 A); and (3) use of the 43-in. telescope in combination with a Barlow lens (extending the focus to an effective focal ratio of f/50) for planetary photography (Venus, Jupiter, and Saturn). Author

N64-18736* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HALL EFFECT DEVICES AS MAGNETOMETERS IN CRYOGENIC APPLICATIONS
Thomas B. Sanford Washington, NASA, Apr. 1964 9 p refs (NASA TN D-2272) OTS: $0.50

Eight representative samples of commercial Hall effect devices were tested at 4.2° K to determine their utility as magnetometers for cryogenic applications. Although cool-down periods of 10 to 15 min were used in an attempt to reduce the thermal shock, several units failed after one or more immersions in liquid helium. The low-temperature behavior of the tested units differed qualitatively from the room-temperature response in that there were oscillations in the Hall voltage as a function of magnetic field. The procedure for use and the low-temperature response of the devices to magnetic fields up to 70 kilogauss are discussed. Author

N64-18776 Princeton U., N.J.
SINGLE CRYSTAL ORIENTER SETTINGS Technical Report No. 6
B. T. Gorres and R. A. Jacobson Sep. 1963 41 p
(Contract DA-ARO(D)-31-124-G265; NSF Grant GP-79)
(AD-434156)

Goniostat settings for all reflections within the desired $\sin^2\theta/\lambda^2$ range are calculated by the Goniostat program. The *hkl* of any axis coincident with the rotation axis of the goniometer head, in addition to the *hkl* and ϕ values of any other axis at $\chi \neq 90°$, serves as input to this program. These axes do not have to be main axes, and since they establish the orientation of the unit cell with regard to the diffraction system, the results need no correction to give actual on-machine settings. The goniostat settings may be sorted by the program in increasing ϕ, χ, and 2θ or left in the generation sequence of increasing *hkl*. If spherical shells are desired, the goniostat settings may be sorted in either increasing ϕ, χ, and 2θ or increasing ϕ, 2θ, and χ. Author

N64-18846 Stanford Research Inst., Menlo Park, Calif.
INSTRUMENTS FOR MEASUREMENT OF DUSTY AIRBLAST EFFECTS IN HIGH OVERPRESSURE REGIONS, PHASE V Final Report
T. D. Witherly Sep. 1963 64 p refs
(Contract DA-49-146-XZ-024)
(DASA 1433; AD-429239)

Instrumentation has been developed for the measurement of dynamic pressures and drag forces in high-velocity, high-pressure airstreams that are laden with dust. The instruments are intended specifically for the high-overpressure regions (up to 500 psi) during atmospheric tests of nuclear weapons over desert surfaces. The development program included the design and construction of: (1) four total pressure probes (SRI-MAD gages) capable of measuring, almost independently, the total pressure of the gas phase and the momentum flux of the suspended dust; (2) four total drag probes to measure directly the drag force on a cylinder; (3) four dust-sampling devices to obtain representative samples of suspended dust for particle-size distribution analyses; and (4) a surface shear gage to measure the magnitude of airblast-induced shear stresses in the soil. Author

N64-18866 General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
FEASIBILITY OF PHOTOPLASTIC RECORDING FOR ELECTROOPTICAL PHOTOGRAPHY Final Report, 9 Jul. 1962-26 Oct. 1963
S. Aftergut and J. Gaynor Griffiss AFB, N.Y., RADC, Feb. 1964 88 p
(Contract AF 30(602)-2853)
(RADC-TDR-63-532; AD-436348)

Photoplastic Recording (PPR) is a photographic process in which images are recorded as surface deformations on a reusable photoconductive thermoplastic film. The image is developed instantaneously by heat and erased only by melting the film. The feasibility of updating information displayed by a cathode ray tube at least five times per minute was demonstrated. Sensitivity, resolving power, contrast and recording parameters such as film surface potential (for sensitization), thickness, and erasure conditions were investigated. Images were schlieren-projected and image quality analyzed. Color projection of PPR images was studied. A PPR recorder was designed and constructed. Operating and servicing instructions are furnished. Author

N64-18872 Southwest Research Inst., San Antonio, Tex
SOME EXPERIMENTS WITH THE SPLIT HOPKINSON PRESSURE BAR Technical Report No. 1
Ulric S. Lindholm 15 Mar. 1964 49 p refs
(Contract DA-23-072-ORD-1674)
(AD-433700)

This paper describes an application of the split Hopkinson pressure bar to the dynamic testing of materials in which the strain vs time, strain rate vs time, stress vs time and stress vs strain may be simultaneously recorded for loading durations on the order of 100 μsec. The method is then employed to determine the strain rate sensitivity of lead, aluminum, and copper; to study the effect of the strain rate history of loading on the stress–strain characteristics of aluminum; and to demonstrate its applicability to a few nonmetallic materials. Author

N64-18974 Joint Publications Research Service, Washington, D.C.
MARINE GEOMORPHOLOGICAL RESEARCH USING THE "LADOGA" PRECISION DEPTH RECORDER
G. B. Udintsev and G. V. Agapova 23 Apr. 1964 33 p refs
Transl. into ENGLISH from Okeanologiya (Moscow), v. 4, no. 1, Jan. 1964 p 156–166
(JPRS-24317; OTS-64-31138) OTS: $1.00

The Ladoga phototelegraph apparatus is adapted to the recording of depths, measured in fathoms, by equipping it with depth-reading scales. These scales are fabricated from transparent organic glass in three sizes, for rates of 60 and 120 prm of the recording roll, and for a rate of 90 rpm. The depth measured in one revolution of the roll is determined by the formula: $H = v \times t/2$, where v is the rated speed of sound in m/sec and t is the time of a complete revolution of the roll in seconds. The depth scale M and the scale division value D are determined in accordance with the following formulas: $M = l/L$ and $D = l/L$, where l is the length of the contact point in one revolution of the roll, in meters, and L is the depth-measurement range during one revolution of the roll, in meters. The simplest method of determining the measurement phase is by means of a cumulative addition of the magnitude of the measuring range after every transition of the

recording to the right edge of the tape under conditions of an increase in depth. In the process of measuring depths, time markings are made automatically on the tape of the Ladoga recorder at an interval of 5 or 10 minutes. Also, the regulation, control, and documentation of the operating regime of the apparatus are discussed. I.v.L.

N64-19029 Lockheed Missiles and Space Co., Sunnyvale, Calif.
CRYOGENIC STRAIN GAGES DEVELOPMENT Preliminary Report
J. Johansson [1964] 33 p
(NSP-64-26)

Two types of foil-strain gages have been tested to determine apparent strain and sensitivity. The gages were applied to fiberglass laminate and tested in CO_2, LN_2, and LH_2. The measured apparent strain due to temperature compares favorably with computed values and also with previous work. The measured sensitivity factors, however, are not entirely satisfactory, making additional research necessary. Author

N64-19044 Atomic Energy of Canada Ltd., Chalk River, Ontario Deep River Lab.
COSMIC RAYS. IQSY INSTRUCTION MANUAL NO. 7
H. Carmichael Feb. 1964 21 p refs
(AECL-1885)

The following are discussed: (1) planning for IQSY; (2) instrument manuals—recommendations of SCRIV (Sub-commission on Cosmic Ray Intensity Variations), recommendations of IQSY working group VII, IQSY instruction manual; (3) neutron monitor specification; (4) cubical meson monitor; (5) general recommendations for data readout, interval identification, and transmission and atmospheric corrections. R.T.K.

N64-19078 Stanford U., Calif. Stanford Linear Accelerator Center
DYNAMIC FIELD MEASUREMENTS WITH AN EMR MAGNETOMETER IN THE PULSED BEAM SWITCHING MAGNET
J. J. Muray and R. A. Scholl Feb. 1964 24 p refs
(Contract AT(04-3)-400)
(SLAC-26) OTS: $0.50

The EMR dynamic field magnetometer has been demonstrated to be an effective tool in the measurement of amplitude jitter in pulsed-magnetic-field waveforms. This instrument is a primary standard, and as such requires no calibration. Conventional means of measuring field jitter, such as a gated integrator and level detector combination, require constant calibration, and hysteresis and time jitter in the level detector itself limit the accuracy. Author

N64-19107 IIT Research Inst., Chicago, Ill.
RESEARCH AND DEVELOPMENT OF AN AUTOMATIC BORANE MONITOR Technical Documentary Report, Aug. 1962-Jul. 1963
Robert S. Braman Edwards AFB, Calif., Res. and Technol. Div., Jul. 1963 57 p refs
(Contract AF 04(611)-7543)
(RTD-TDR-63-1072; AD-420004)

A portable, continuous automatic flame-emission pentaborane-in-air monitor has been developed having a sensitivity of 10 parts per billion. The technique is comparatively free from interference and unaffected by momentary high concentrations of volatile materials. Instrumentation and electronic developments as well as calibration and interference tests are given. Author

N64-19139 Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
A SENSITIVE VIBRATION MAGNETOMETER
Kurt J. Linden Jan. 1964 26 p refs
(AFCRL-64-13; AD-435618)

A vibrating sample magnetometer capable of measuring magnetic moments as small as 2×10^{-6} emu (gauss-cm^3) has been put into operation. The instrument is basically of the Foner type, consisting of a speaker-driven rod holding the sample at one end. For measurements between 4.2° and 77° K, the sample is located in the inner part of a double dewar system, and the signal coils are rigidly mounted and immersed in the liquid nitrogen of the outer dewar. By immersion of the coils in liquid nitrogen, the thermal noise voltage is reduced by a factor of seven below that at 300° K, and a sensitivity of 2×10^{-6} emu is thereby achieved. For temperatures between 77° and 600° K, cryogenic coil techniques require an increase in sample to coil distance that more than offsets the improvement due to reduced thermal noise. In order to achieve high sample temperatures and still maintain the coils at as low a temperature and as close to the sample as possible, a lava coil holder is used in which precooled gas can be passed around the coils. Author

N64-19154* David Sarnoff Research Center, Princeton, N.J.
THE STRATOSCOPE II TELEVISION SYSTEM
L. E. Flory, W. S. Pike, J. M. Morgan, and L. A. Boyer Repr. from the J. Soc. Motion Picture Television Engr., v. 73, no.1 Jan. 1964 p 3–8 refs
(Sponsored by NASA, NSF, and ONR)

Stratoscope II is a large and complex balloon-borne astronomical telescope operated in the stratosphere by radio command. This paper describes the television system developed for this equipment. Results of the instrument's first flight are briefly described, and plans for future flights are outlined. Author

N64-19188 Dewey (G. C.) Corp., New York, N.Y.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR First Quarterly Progress Report, 1 Jul.-30 Sep. 1963
M. N. Hirsh and P. N. Eisner 30 Sep. 1963 18 p
(Contract DA-36-039-AMC-03278(E))
(R-173-1; AD-433774)

The purpose of this study is the measurement of reaction rates for various charge production and loss mechanisms in electron-irradiated air and atmospheric gases. Progress is reported on the construction of an RF mass spectrometer for use in ion and neutral species identification and measurement, and in the preparation of the vacuum system for bakeout at elevated temperatures. R.T.K.

N64-19203 David Taylor Model Basin, Washington, D.C.
MEASUREMENTS OF THE FLUCTUATING STATIC AND TOTAL-HEAD PRESSURES IN A TURBULENT WAKE
M. Strasberg Dec. 1963 30 p refs Presented at a Symp. on the Mechanism of Noise Generation in Turbulent Flow, Brussels, Belgium, 1–5 Apr. 1963
(DTMB-1779; AD-428700)

The use of probe tubes for measuring the fluctuating static and stagnation-point pressures in subsonic turbulent wakes is discussed, and estimates are made of the magnitude of several sources of error. It is shown that the mere presence of a probe tube in a turbulent flow causes the measured mean-square value of the fluctuating static pressure to exceed the true value by

about $1/4(\rho v_t^2)^2$, where v_t is the fluctuating velocity component normal to the tube. Although this error is about equal to the magnitude of the fluctuations expected in isotropic turbulence, the fluctuations in shear flows can exceed the error by enough to be measurable. The results of measurements of fluctuating pressure made in the wake behind a cylinder are presented. Data are given on the rms values and the spectra of the fluctuating static and total-head pressures, and on the cross correlations of these pressures with the fluctuating velocity. Author

N64-19209 Texas Instruments, Inc., Dallas
BROADBAND DIGITAL SEISMOMETER EVALUATION
Final Report
H. L. Lake 21 Feb. 1964 98 p refs
(Contract AF 19(628)-2986)
(AFCRL-64-33; AD-433679)

Ambient seismic noise and several large earthquakes were recorded at the same location, using both velocity and displacement-sensing seismograph systems. These data were evaluated for information content by application of convolution filters designed to map outputs from the broadband instruments into the outputs of conventional narrowband systems and into each other. The broadband displacement seismometer was tested for static and dynamic linearity and for the response determined from shake-table measurements. The velocity instrument was constructed, with minor modifications, from off-the-shelf components. The necessary dynamic range for the two types of broadband-seismometer systems was examined, and studies were carried out to determine the effectiveness of both types for broadband recordings. Author

N64-19210 Columbia U., Palisades, N.Y. Lamont Geological Observatory
CALIBRATION OF LONG-PERIOD SEISMOGRAPHS AT THIRTEEN STATIONS THROUGHOUT THE WORLD
Henry J. Miller Sep. 1963 60 p refs
(Contract AF 19(604)-7376)
(AFCRL-63-905; AD-435981; Sci. Rept.-24)

Accurate calibrations were made of 42 special seismographs located in Bermuda, Buenos Aires, Delhi, Hong Kong, Honolulu, Huancayo, Mt. Tsukuba, Perth, Rio de Janeiro, Santiago, Suva, Uppsala, and Waynesburg. Two methods of calibration were used—one based on a steady-state input signal, and the other on a transient pulse-like input signal. The signals were applied through a Willmore-type bridge. Analysis of the steady-state output was conventional; analysis of the pulse was made by a comparison with a family of theoretical pulses obtained with an analog computer. Both methods provide displacement sensitivity and phase response curves. The instruments were calibrated according to the existing conditions, and were then adjusted for standardization and recalibrated. The bridge and the pulse-generating circuit were installed permanently for frequent calibration in the future. The results of the calibrations are given graphically. Author

N64-19240 Harry Diamond Labs., Washington, D.C.
A HIGH ISOLATION ABSORPTION MODULATOR-SWITCH FOR 1.2-CM WAVELENGTH
Frank Reggia 8 Jul. 1963 19 p refs
(TR-1151; AD-414581)

This report describes the design and operation of a K-band absorption modulator for high-speed switching or amplitude modulation of microwave power. This reciprocal ferrite modulator, designed in standard rectangular waveguide and making use of a longitudinal magnetic control field, has electrical characteristics particularly desirable in a microwave switch. These include a zero-field insertion loss of less than 1 db, a switching action (isolation) of greater than 75 db that is nearly independent of the magnetic control field in this state, and a matched input impedance for all values of applied field. These electrical characteristics are nearly constant over a 20-percent bandwidth. It is also possible to design this amplitude modulator for small phase shifts at the desired operating frequency. Other characteristics of the modulator include small size (3 in. max. length), magnetic control fields of less than 50 oersteds, operating temperature exceeding 100° C, and a switching-time capability of less than 0.1 μsec. Author

N64-19254* Ohio State U. Research Foundation, Columbus
RADIOMETRY IN THE SUBMILLIMETER REGION USING THE INTERFEROMETRIC MODULATOR
R. A. Williams and W. S. C. Chang Repr. from IEEE Trans. on Microwave Theory and Tech., v. 11, no. 6, Nov. 1963 p 513–522 Presented at Millimeter and Submillimeter Conf., Orlando, Fla., 7–10 Jan. 1963
(NASA Grant NsG-74-60)

The interferometric modulator, which has already been used in far infrared spectrometers, is proposed as the major component of a practical submillimeter radiometer. Its use as the wave-number-selection device in a radiometer is analyzed, and estimates are obtained for the sensitivity of this submillimeter radiometer. It is estimated that a 0.2° C minimum detectable temperature differential is achievable with this radiometer. Also discussed are the effects of atmospheric water vapor absorption and the sensitivity of a number of different types of radiation detectors suitable for use in the submillimeter-wavelength region. Author

N64-19263 Naval Research Lab., Washington, D.C.
AUTOMATIC COMPUTATION AND PLOTTING OF SPECTRAL RESPONSE DATA
R. J. Lambert *In its* Rept. on NRL Progr. Feb. 1964 p 7–13 refs (See N64-19261 11-01) OTS: $1.25

A system has been developed for direct data processing and display of continuously varying outputs from experimental processes. The system has been used to obtain spectral response curves for solar cells. A desk model transistorized analog computer is used for computation, and readout is accomplished by an X-Y recorder. Application of the system for use as a "solar simulator" is described. Author

N64-19283 Pratt and Whitney Aircraft, Middletown, Conn.
DEVELOPMENT OF LIQUID METAL LEVEL PROBES
Salvatore J. Fanciullo 27 Apr. 1964 63 p refs
(Contract AT(30-1)-2789)
(PWAC-423) OTS: $1.50

Evaluations of several liquid metal level-measuring devices led to the selection of a resistance-type probe for both continuous and discrete level measurements. This device is fabricated from a section of two to four conductor, metal-clad, ceramic-insulated, swaged material. The continuous level probe is bent into a "J" configuration, welded into the liquid metal containment vessel, and cap welded at one end. Tests on various configurations of this device have led to the development of a J-probe which has less than 0.5% shift in calibration for a 1,200° F change in temperature, and less than a 1% shift in calibration after 500 hours at 1,000° F. After a short time complete wetting occurs and, with proper surface preparation, errors due to this effect can be reduced to less than 2% after 2 minutes. These probes have been successfully applied

to many test rigs. For discrete (one point) level determination, a straight probe has been designed. This I-probe is capable of giving a very accurate and reliable indication of liquid level at one point. Author

N64-19290 National Aeronautical Lab., Bangalore (India)
DEVELOPMENT OF A RAMP TYPE DIGITAL VOLTMETER
R. Srinivasan Jul. 1963 34 p refs
(TN-SE-4-63)

A ramp-type digital voltmeter has been designed and constructed in the laboratory, which can measure voltages from 0 to 10v at the input with an accuracy of 1% (full scale). The output is visually displayed in decimal notation, the time taken for conversion being 1 second or less. The main design and performance features of the digital voltmeter are discussed in this note. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-18517 Joint Publications Research Service, Washington, D.C.
BIOPHYSICAL STUDIES OF AMINO ACIDS AND PROTEINS
6 Apr. 1964 18 p refs Transl. into ENGLISH of selected articles from Biofizika (Moscow), v. 8, no. 5 1963 p 536–542, 556–560
(JPRS-24046; OTS-64-21990) OTS: $0.50

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2. PECULIARITIES OF THE ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF AMINO ACIDS AND PROTEINS UNDER THE ACTION OF ULTRAVIOLET LIGHT O. A. Azizova p 10–15 refs (See N64-18519 11-16)

N64-18518 Joint Publications Research Service, Washington, D.C.
ON THE PROBLEM OF CORRELATION AMONG NEIGHBORING AMINO ACID RADICALS IN PROTEIN MOLECULES
V. Yu. Urbakh *In its* Biophys. Studies of Amino Acids and Proteins 6 Apr. 1964 p 1–9 refs (See N64-18517 11-16)

The degree of correlation of the amino acid radicals in a polypeptide chain can serve as one of the indices for characterizing the structure of protein molecules. The correlation problem deals with whether forbidden combinations of neighboring radicals exist, whether some combinations are observed more frequently than others, etc. Moreover, correlation can exist in principle not only among neighboring radicals, but also among farther removed radicals. This report evaluates quantitatively the degree of correlation of the radicals and isolates the portion of correlation that is due to correlation among neighboring radicals. This is accomplished by using the methods of information theory, as well as by using the analogy between the sequences of amino radicals in proteins and the sequence of letters in a text. I.v.L.

N64-18519 Joint Publications Research Service, Washington, D.C.
PECULIARITIES OF THE ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF AMINO ACIDS AND PROTEINS UNDER THE ACTION OF ULTRAVIOLET LIGHT
O. A. Azizova *In its* Biophys. Studies of Amino Acids and Proteins 6 Apr. 1964 p 10–15 refs (See N64-18517 11-16)

The EPR spectra of UV-irradiated sulfur-containing amino acids were measured. A mechanism was proposed to explain the appearance and transformation of the radicals during UV irradiation. The EPR spectra of UV-irradiated aromatic amino acids were studied. EPR spectra of various proteins, irradiated by UV, were taken; the kinetics of the change of the EPR signals of the proteins as a function of the temperature was studied. Author

N64-18520 Joint Publications Research Service, Washington, D.C.
STUDIES IN BLOOD TRANSFUSION
9 Apr. 1964 43 p refs Transl. into ENGLISH of 4 articles from Probl. Gematol. i Perelio. Krovi (Moscow), v. 10, no. 2, Feb. 1964 p 37–55
(JPRS-24118; OTS-64-31034) OTS: $1.25

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2. ANTICOAGULANT EFFECT IN INFUSIONS OF THE PROTEIN BLOOD SUBSTITUTE BK-8 D. G. Petrov and B. T. Savkiv p 13–21 refs (See N64-18522 11-16)
3. HISTOCHEMICAL AND FUNCTIONAL STUDY OF RETICULOENDOTHELIAL SYSTEM IN EXPERIMENTAL ANIMALS FOLLOWING THE INFUSION OF BLOOD EXPANDER SOLUTION OF POLYVINOL Z. A. Chaplygina and V. P. Teodorovich p 22–32 refs (See N64-18523 11-16)
4. CHARACTERISTICS OF THE AMINO ACID COMPOSITION OF THE PROTEIN HYDROLYZATE "TsOLIPK" A. M. Kharat'yan and K. Yu. Yuldoaskev p 33–40 refs (See N64-18524 11-16)

N64-18521 Joint Publications Research Service, Washington, D.C.
PLASMA PROTEIN FRACTIONS FOLLOWING REPLACEMENT OF LOST BLOOD WITH POLYGLUCIN
V. B. Koziner and N. D. Papush (Inst. of Hematology and Blood Transfusion) *In its* Studies in Blood Transfusion 9 Apr. 1964 p 1–12 refs (See N64-18520 11-16) OTS: $1.25

Plasma protein fractions following the replacement of lost blood, from exsanguinated dogs, with polyglucin were studied. These protein fractions were albumin, alpha$_1$-globulin, alpha$_2$-globulin, alpha$_3$-globulin, beta$_1$-globulin, beta$_2$-globulin and fibrinogen, and gamma-globulin. The concentration of these plasma proteins, in percentages, after blood loss and infusion of polyglucin as well as infusion of physiological solution are presented in tabular form. It was shown that the general progress of the restoration of plasma proteins and the infusion of polyglucin has the same character as in the event of blood loss treated only with physiological solution. Consequently, polyglucin does not disturb the natural progress of the restoration of plasma proteins and their fractions following the loss of blood. I.v.L.

N64-18522 Joint Publications Research Service, Washington, D.C.
ANTICOAGULANT EFFECT IN INFUSIONS OF THE PROTEIN BLOOD SUBSTITUTE BK-8
D. G. Petrov and B. T. Savkiv (L'vov Sci. Res. Inst.) *In its* Studies in Blood Transfusion 9 Apr. 1964 p 13–21 refs (See N64-18520 11-16) OTS: $1.25

A clinical study was conducted of the anticoagulant effect of infusions of the protein blood substitute BK-8. Results indicate that: (1) The retardation of blood clotting that follows the infusion of BK-8 is associated with disturbances in the formation of thromboplastin, both quantitatively and qualitatively. (2) Infusions of BK-8 should not be given more often than once every 3 to 4 days in a dose not exceeding 500 to 750 ml. (3) The use of BK-8 has some point, perhaps, in the case of patients with a tendency toward thrombopoiesis. (4) The BK-8 infusion must not be given if a tendency toward hemophilia is present. Also, a peculiar kind of hemorrhagic diathesis that developed in a patient as a result of repeated infusion of BK-8 is discussed. I.v.L.

N64-18523 Joint Publications Research Service, Washington, D.C.
HISTOCHEMICAL AND FUNCTIONAL STUDY OF RETICULOENDOTHELIAL SYSTEM IN EXPERIMENTAL ANIMALS FOLLOWING THE INFUSION OF BLOOD EXPANDER SOLUTION OF POLYVINOL
Z. A. Chaplygina and V. P. Teodorovich (Leningrad Sci. Res. Inst.) *In its* Studies in Blood Transfusion 9 Apr. 1964 p 22–32 refs (See N64-18520 11-16) OTS: $1.25

A solution of polyvinyl alcohol was administered to rats and dogs. The animals were sacrificed at various times thereafter, and their liver, kidney, and spleen tissues were examined. A histochemical study of these tissues showed the inclusion of polyvinyl alcohol in the reticuloendothelial cells, and that this inclusion does not inhibit the phagocytic activity of the reticuloendothelium system. I.v.L.

N64-18524 Joint Publications Research Service, Washington, D.C.
CHARACTERISTICS OF THE AMINO ACID COMPOSITION OF THE PROTEIN HYDROLYZATE "TsOLIPK"
A. M. Kharat'yan and K. Yu. Yuldashev (Tashkent Med. Inst.) *In its* Studies in Blood Transfusion 9 Apr. 1964 p 33–40 refs (See N64-18520 11-16) OTS: $1.25

The amino acid composition of the protein hydrolyzate TsOLIPK was investigated by means of two-dimensional chromatograms. The amino acids were quantitated, using the Bode method, on one-dimensional chromatograms after repeated passage of the solvent (n-butanol–water–acetic acid). For chromatographic analysis, the TsOLIPK was taken in the form in which it is administered to patients, as well as after additional complete hydrolysis. The following amino acids were detected in the free form: glycine, cystine, aspartic and glutamic acids, serine, threonine, alanine, tyrosine, valine, phenylalanine, proline, and a joint spot of leucine and isoleucine. Also, methionine sulfone (from methionine) was detected. In addition, five to six spots belonging to the peptides were identified. Some of these spots coincided with the position of lysine, arginine, and histidine, which impeded the identification of these acids and their quantitative determination in the incomplete hydrolyzate. Methionine and tryptophan were not separated as separate spots. The mean concentration of the individual amino acids (in mg%) in the hydrolyzate following complete hydrolysis is presented. This qualitative analysis shows that the TsOLIPK contains all the amino acids indispensable to man, which explains its good nutritive properties. I.v.L.

N64-18600 Foote Mineral Co., Exton, Pa. Research and Engineering Center
A STUDY OF THE APPLICATION OF LITHIUM CHEMICALS TO AIR REGENERATION TECHNIQUES IN MANNED, SEALED ENVIRONMENTS Technical Documentary Report, Jun. 1962–Jan. 1963
Meyer M. Markowitz and Eugene W. Dezmelyk Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., Feb. 1964 208 p refs (Contract AF 33(657)-9124)
(AMRL-TDR-64-1; AD-435815) OTS: $3.50

A thermochemically self-propagating oxygen-generating composition was formulated of 84.82% (by weight) lithium perchlorate oxidant, 10.94% manganese metal powder fuel, and 4.24% lithium peroxide chlorine suppressant additive after an extensive study of lithium perchlorate–fuel interactions. The average available oxygen content from the combustion of this composition is 49.2% (by weight). At a compacted density of 2.32 grams/cc., the oxygen content of the mixture is equivalent to that of an equal volume of liquid oxygen at its boiling point of −183° C. Engineering design and development of prototype equipment to supply the oxygen requirement for 1 man-day and to absorb the carbon dioxide output for 1 man-day were successfully completed by fabrication and testing of a lithium perchlorate-based oxygen generator and a lithium peroxide-based carbon dioxide absorption unit. Author

N64-18629 Northrop Corp., Hawthorne, Calif. Space Labs.
MODEL ASTRONAUT RADIATION DOSE DISTRIBUTION ANALYSIS
R. E. Fortney and G. E. Duckworth Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., Feb. 1964 27 p refs
(Contract AF 33(657)-11010)
(AMRL-TDR-64-9; NSL-63-172; AD-435734)

The basis of the mathematical formulation for determining the dose distribution is presented. Particles of the ambient environment were assumed to impinge isotropically on the Apollo Command Module (CM). The radiation was attenuated through a typical vehicle wall thickness, and mean dose rates at various depths in a model astronaut were calculated. Four depths were investigated, each having approximately 175 points at which the dose was calculated. Two spectra was considered—one for Van Allen protons and the other representing solar flare protons. The results are presented in graphical form, giving dose versus depth in the model astronaut. Author

N64-18632 ARO, Inc., Arnold Air Force Station, Tenn.
VON KARMAN GAS DYNAMICS FACILITY, TECHNICAL DEVELOPMENTS
J. Lukasiewicz Arnold Eng. Develop. Center, 1964 83 p refs (AD-435787)

The following are discussed: (1) aerodynamics—analytical studies, supersonic and hypersonic flows, aerodynamic controls, and boundary-layer control at supersonic speeds; (2) hypervelocity impact—formation of craters, and target rear-surface fracture resulting from high-speed impact; and (3) experimental techniques—supersonic and hypersonic tunnels, the development of hotshot-type wind tunnels, low-density facility, hypervelocity ranges, and instrumentation. R.T.K.

N64-18650 New York Medical Coll., N.Y.
THE EAR OF THE CHIMPANZEE
E. L. House, B. Pansky, M. S. Jacobs, and B. M. Wagner Holloman AFB, N. Mex., 6571st Aeromedical Res. Lab., Jan. 1964 347 p refs
(Contract AF 29(600)-3022)
(ARL-TDR-64-1; AD-434758)

The gross and microscopic anatomy of the petrous portion of the chimpanzee temporal bone, with particular emphasis on the histology of the middle and inner ears, is described. This description is supplemented by multiple gross and microscopic photographs of the more crucial anatomical landmarks. Photographs of a wax-plate reconstruction of a chimpanzee petrous bone exhibiting anatomical relationships within the inner and middle ears are included. Author

N64-18665 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
OVERLOADING AND WAY OF INCREASE OF ENDURANCE OF ORGANISM
V. Stepantsov and G. Khlebnikov 17 Apr. 1963 13 p refs Transl. into ENGLISH from Aviats. i Kosmonav. (Moscow), no. 1, 1963 p 44–48
(FTD-MT-63-20/1; AD-434948)

The effects of positive transverse and longitudinal loadings on aircraft pilots and astronauts are discussed. Effective means for increasing the ability to endure the influence of positive overloadings are the centrifuge, acrobatics, gymnastics, and "passive" training on the special revolving table. Negative overloadings are also discussed. I.v.L.

N64-18672 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ACTION OF GIBBERELLIC ACID ON PROTOCOCCALES
V. V. Pinevich, N. N. Verzilin, and V. E. Vaileva 12 Nov. 1963 13 p refs Transl. into ENGLISH from Nauchn. Dok. Vysshey Shkoly, Biol. Nauki (Moscow), no. 3, 1961 p 151–154
(FTD-MT-63-49; AD-434937)

The effect of indolyl acetic acid (IAA) and indolyl butyric acid (IBA) on *Chlorella pyrenoidosa* was studied. Growth stimulators were applied in concentrations of 10^{-4}, 10^{-3}, 10^{-2}, 10^{-1}, and 10^{0} milligrams/liter of suspension. It was found that the IAA and IBA in concentration of 10^{-2} and 10^{-3} milligrams/liter intensify the division of cells, but lower the accumulation of dry substance. At the IAA and IBA concentration of 10^{0} milligrams/liter of suspension, there is a suppression of cell division, but the size of the cells increases. A series of experiments were also conducted in order to ascertain the effect of gibberellic acid (GA) on the growth of *Chlorella pyrenoidosa*. Under the influence of GA in concentrations of 10^{-2} and 10^{-1} milligrams/liter, the quantity of *Chlorella pyrenoidosa* and the total harvest of water plants are increased. R.T.K.

N64-18773 Boeing Co., Seattle, Wash.
EFFECTS OF SIMULATED AEROSPACE SYSTEM ENVIRONMENTS ON THE GROWTH OF SELECTED ANGIOSPERMS Technical Documentary Report, Jun. 1962–Jun. 1963
G. M. Christensen et al Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs. (6570th), Dec. 1963 65 p refs
(Contract AF 33(657)-8341)
(AMRL-TDR-63-131; AD-434684) OTS: $1.75

A series of detailed studies were performed to evaluate the growth of selected angiosperms on substrates composed of the effluent from waste disposal processes and to measure growth and photosynthesis under a variety of atmospheres and lighting conditions. The plants used most extensively were *Brassica chinensis* (Chinese cabbage), *Amaranthus gangeticus* (Tampala), and *Chicorium endiva* (endive). Some preliminary experimentation was also performed using *Beta vulgaris cicla* (Swiss chard) and two other members of the genus *Brassica*, kale and collards. The results indicate that growth on effluents of biological waste disposal processes will be satisfactory only upon supplementation, further treatment, or adaptation to the effluent. Growth under narrow-band fluorescent lamps, or under combinations of several colored lights, in no case approached that observed under light sources that were specifically designed to promote plant growth. Author

N64-18789 Iowa State U., Iowa City
WATER RECOVERY BY FREEZE DRYING USING MICROWAVE ENERGY
A. F. Vetter and Karl Kammermeyer Wright-Patterson AFB, Ohio, 6570th Aerospace Med. Res. Lab., Dec. 1963 66 p refs
(Contract AF 33(657)-9263)
(AMRL-TDR-63-130; AD-434801) OTS: $1.75

The recovery of water from urine by the freeze-drying process, using a microwave energy source, is investigated. Chemical and biological contaminants are well below the standards established by the U.S. Public Health Service. Taste and odor of the reclaimed water are satisfactory for drinking purposes without additional treatment. Various foam and sponge materials for use in zero-gravity environments were tested. Yield rate studies were performed, using such variables as power input, geometrical configuration, use of sponge and foam materials, and comparison of prefrozen and vacuum-frozen samples. A suggested apparatus design is presented, and space and power requirements are discussed. Author

N64-18826 Air Force Systems Command, Wright-Patterson AFB, Ohio
INFORMATION PROCESSING BY LIVING ORGANISMS AND MACHINES. 1963 BIONICS SYMPOSIUM
Mar. 1964 360 p refs Symp. held at Dayton, Ohio, 19–21 Mar. 1964 Sponsored jointly by Aeron. Systems Div. and Aerospace Med. Div.
(ASD-TDR-63-946; AD-435982)

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18. AN ANALYTICAL MODEL FOR ANALYSIS AND SYNTHESIS OF IMITATIVE ELECTRONIC MECHANISMS D. A. De Salvo and C. K. Kim (Systems Res. Labs.) p 348 Abstract Only

N64-18827 Minnesota U., Minneapolis
SIGNALS ASSIMILABLE BY LIVING ORGANISMS AND BY MACHINES
Otto H. Schmitt *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 5–12 (See N64-18826 11-16)

The following aspects of bionics are discussed: the biological goals, the mathematics, the computer hardware used, electronics in medicine, and manpower and education in bioengineering. R.T.K.

N64-18828 Illinois U., Urbana
SYSTEMS AND INFORMATION
W. Ross Ashby *In* AF Systems Command, Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 13–18 refs (See N64-18826 11-16)

The elementary principles of bionics are described in terms of the logic of mechanisms. This logic is developed according to the algebraic method proposed by Bourbaki. Information theory is discussed. It is defined as being a method for retaining some knowledge of cause–effect relations when the causes and their effects become so numerous that detailed knowledge of each pair is abandoned; an overall check is retained so that the number of causes is sufficient to account for the number of effects. Complex systems and the theory and logic of simplification are also discussed. R.T.K.

N64-18829 Massachusetts Inst. of Tech., Cambridge, Mass.
OBSERVATIONS ON COLOR VISION
Jerome Y. Lettvin *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 20–31 refs (See N64-18826 11-16)
(Contract AF 33(616)-7783; NSF Grant 16526; NIH Grant NB-01865-05; NIH Grant MH-04737-03)

The aperture mode of color perception is discussed. It uses a trichromatic method for matching colors. The theory of color vision that is suggested is that all of the cones bear all of the pigments but in different ways. Arguments are presented in support of this theory. The disadvantages inherent in the theory are also discussed. R.T.K.

N64-18830 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE USE OF ANATOMICAL AND PHYSIOLOGICAL EVIDENCE IN THEORY CONSTRUCTION
William D. Neff *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 32 Abstract only (See N64-18826 11-16)

In the formulation of theories of information processing in sensory systems or theories of sensory discrimination, selected bands of the total spectrum of data are typically utilized. A brief review of evidence bearing upon one sensory system, the auditory system, is given. An attempt is made to ascertain whether researchers in theory construction make use of and organize the total accumulation of information, or whether they devise superficial models and select only those pieces of evidence that support a particular idea. Author

N64-18831 Erlangen U. (W. Germany) Inst. of Physiology
TUNING BETWEEN CENTRAL AUDITORY PATHWAYS AND THE EAR
Wolf D. Keidel *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 33–60 refs (See N64-18826 11-16)

A modern physiological concept is presented of the sensory optimizing system of the CNS (central nervous system). The latter performs the function of selecting the information reaching the threshold of consciousness. The "optimizing function" of the human CNS is effected by: (1) the modulation of the "specific information" by the "unspecific" passing the reticular formation of the brain stem; and (2) the descending fiber systems that selectively attenuate the "specific information", depending on both intensity and frequency in the auditory channel that attenuate on every level of the sensory pathway. Also discussed is the special tuning system responsible for the synergism of frequency (pitch) discrimination and periodicity analysis. R.T.K.

N64-18832 Collège de France, Paris
GLIAL CONTROL OF NEURONAL ACTIVITY
Leo E. Lipetz (Ohio State U.) *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 61–87 refs (See N64-18826 11-16)
(PHS Grant B-1408)

The concept that the activity of neurons is both passively and actively modified by the surrounding glial and other nonneuronal cells is supported, but not conclusively demonstrated, by recent and previously unreported experiments. The evidence makes such nonneuronal control seem very likely in the vertebrate retina. In particular, the nonneuronal horizontal cells of the retina were found to summate and transmit changes in their membrane potentials (the L-response type of S-potential) over distances many times the span of a single such cell. Potential changes can affect the neuronal transmission of excitation from the photoreceptors to the ganglion cells, and may be

a basis for a mechanism accounting for the low-luminance portion of light adaptation and for certain retinal functions of spatial summation and movement detection. Author

N64-18833 Massachusetts Inst. of Tech., Cambridge
HOW THE LOCATION OF A STIMULUS IS CORRECTLY SIGNALLED TO THE CENTRAL NERVOUS SYSTEM
Karl Kornacker and Patrick D. Wall *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 89–92 refs (See N64-18826 11-16)
(NIH Grant NB-01865-05)

Experimental results gained from studying amphibians are presented to support the fact that most of the highly refined information operations performed by the central nervous system become worthless if the precisely ordered connections between the peripheral sense organs and the central nervous system are disorganized. R.T.K.

N64-18834 California U., Berkeley
LIMITS OF GENETIC CONTROL
H. J. Bremermann *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 93–104 refs (See N64-18826 11-16)
(Contract Nonr-222(85))

In simple cases the amount of information required for control of behavior and specification of structure can be estimated. If unconstrained, n stimulus-response pairs require $n(\log_2 n/e)$ bits (for large n). Linguistic notions and their denotations may be considered as unconstrained stimulus-response pairs. A language of 1,200 words constitutes about 10^4 bits. This number is of the order of magnitude of the number of genes in human somatic cells. If each gene has two different states (alleles), then each gene represents at most one bit of information. If a language and its understanding are to be innate, then its information content must not exceed the information capacity of the genes. Hence an innate language cannot contain more than about 1,200 words. Similarly, the structure of the human brain must be to some degree random or repetitive. The genes cannot specify each individual interconnection between neurons. Antibody formation must be an adaptive process, otherwise the antigen-antibody pairs are constrained. Author

N64-18835 Chicago U., Ill. Committee on Mathematical Biology
MATHEMATICAL MODELS OF NEURAL ACTIVITY
H. D. Landahl *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 105–123 refs (See N64-18826 11-16)
(AF AFOSR Grant 62-117)

A brief review is presented of a mathematical representation of neural activity, together with some applications. This mathematical model of neural elements is used to describe psychological situations. R.T.K.

N64-18836 Santa Rita Technology, Inc., Menlo Park, Calif. Bioacoustics Lab. Inc.
LIMITS TO ANIMAL DISCRIMINATION AND RECOGNITION IN A NOISE-FREE EXTERNAL ENVIRONMENT
John L. Stewart *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 124–159 refs (See N64-18826 11-16)

One- and two-dimensional sensory mechanisms, corresponding to one patch and a line array, respectively, of sensory cells are analyzed. A fundamental stimulus conversion law to average neural pulse rate is employed to explain several phenomena in psychophysics. A theory for neural noise is developed that is shown to specify the limits to animal discrimination and to explain certain observed neural mechanisms. Concepts of optimum detection are employed to specify the ideal animal recognition sensory schema as limited by constraints associated with unavoidable neural noise. Actual animal mechanisms appear to follow the ideal. Certain aspects of Gestalt psychology are also evidenced. The general theory provides quantitative insight into artificial animal recognition and information-handling systems and indicates the extent to which the capability of a mechanical device can equal or exceed that of its living counterpart. Explicit design considerations for implementation of the ideal artificial animal system are provided. Author

N64-18837 Illinois U., Urbana
MOLECULAR BIONICS
Heinz Von Foerster *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 161–190 refs (See N64-18826 11-16)
(Contract AF 33(657)-10659; AF AFOSR Grant 7-63)

Three features of macromolecular structures are discussed in order to provide clues to the behavior of aggregates of such molecules in living matter. These features are: (1) storage of information, (2) manipulation of information (computation), and (3) manipulation of information associated with energy transfer. R.T.K.

N64-18838 Case Inst. of Tech., Cleveland, Ohio Systems Research Center
MULTI-LEVEL HEURISTIC AND PROBLEM SOLVING
Mihajlo D. Mesarović *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 192–205 refs (See N64-18826 11-16)

It has been suggested that simulation of biologic systems and, in particular, brainlike mechanisms should not be based on a loosely structured network, but rather that a multilevel, multigoal structuring of the systems is preferable, if not mandatory, for proper understanding of the behavior. The principal characteristic of the proposed multilevel approach is the simultaneous operation (parallel computation) of the units on the same as well as on different levels. This is essential for the proper coordination action of the higher level units. In particular, the application of the multilevel approach to the heuristic theorem proving is considered. Author

N64-18839 Massachusetts Inst. of Tech., Cambridge
REALIZABILITY OF INDUCTIVE LOGIC
M. C. Goodall *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 206–226 refs (See N64-18826 11-16)
(Contract AF 33(616)-7783; NIH Grant NB-01865-05)

The basic model is a two-way communication system in which observer O transmits axioms A, interprets received message S^* by rules, R, of a Post normal logic. O's strategy is to generate (applying R to A) derivations S that minimize d(S,S^*). subject (among other things) to R being Turing universal. This implies that (A,R:S^*) are analogs of complementary observables and interaction potential in quantum mechanics. Author

N64-18841 System Research, Ltd., Richmond, (Gt. Brit.)
SELF-ORGANISING SYSTEMS INVOLVED IN HUMAN LEARNING AND PERFORMANCE
Gordon Pask *In* AF Systems Command Inform. Process. by Living Organisms and Machines. 1963 Bionics Symp. Mar. 1964 p 247–338 refs (See N64-18826 11-16)
(Contract AF 61(052)-402; Contract AF 61(052)-640)

Discussed is the coupled system formed when one or more human beings interact with an adaptive machine. Systems of this kind are examined in connection with teaching (the adaptive machine has the role of an instructor, programed to teach a skill), with testing (the adaptive machine is programed to perform a sequence of experiments that yield maximum information about a chosen aspect of human behavior) and with coding, when the adaptive machine is an aid to performance and cooperates with the man. The adaptive machine, as part of its job in stabilizing the coupled system, builds up a cybernetic or bionic "model" of the man with which it interacts; this coupled man–machine system is a self-organizing system. Bionic models are described and compared. Metalinguistic descriptions of coupled systems are constructed. The basic logical requirements for a theoretical framework are discussed. Author

N64-18868 Naval Research Lab., Washington, D.C.
THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES Third Annual Progress Report
H. W. Carhart and V. R. Piatt, ed. 31 Dec. 1963 69 p refs
(NRL-6053; AD-435518)

Emphasis is, at present, being devoted almost exclusively to nuclear-powered submarines. Considerable progress has been made in the major efforts of developing: (1) the sulfate-cycle system for the electrolytic generation of oxygen from water and the absorption of carbon dioxide; (2) additives to decrease the degradation of monoethanolamine (MEA) in the CO_2 scrubber; and (3) improved methods of sampling and analysis of atmospheres. Other topics covered include the use of algae for oxygen production and carbon dioxide absorption, an assessment of CO_2 removal systems, and catalytic combustion studies using hopcalite. Author

N64-18874 Utah U., Salt Lake City Utah Coll. of Medicine
EFFECT OF ACCLIMATIZATION TO 2°C ON HOST SUSCEPTIBILITY TO KLEBSIELLA PNEUMONIAE CHALLENGE
S. Marcus, F. Miya, and L. J. Phelps Ft. Wainwright, Alaska, Arctic Aeromedical Lab., Sep. 1963 11 p refs
(Contract AF 41(657)-311)
(AAL-TDR-63-9; AD-434114)

Adult albino mice were exposed to 2° C in groups for varying time periods prior to challenge intraperitoneally with 1 LD_{50} of *Klebsiella pneumoniae*. Animals exposed to the low temperature for up to five days prior to challenge showed no significant differences in mortality from the controls. Statistically significant survival ratios were obtained if the mice were exposed to cold for more than five days prior to challenge. No deaths were observed in comparable specifically immunized groups of animals. Author

N64-18886 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
TRANSIENT CHANGES IN ARTERIAL LACTIC ACID OF DOGS AT 21,000 FEET
Stephen M. Cain and James E. Dunn II Mar. 1964 10 p refs
(SAM-TDR-64-2; AD-434870)

After a 3-hour control period at ground level, unanesthetized dogs were exposed for 8 hours to 21,000 feet simulated altitude (P_B = 335 mm Hg). Arterial blood samples were drawn frequently from a Teflon T-cannula surgically placed in a carotid artery 1 or 2 days prior to the experiment. Lactic and pyruvic acid concentrations, P_{CO_2}, P_{O_2}, and pH were measured. At altitude, the average arterial P_{O_2} was 32 mm Hg; P_{CO_2} was 24 mm Hg. The pH was 7.50. All control values fell in normal ranges. Although the magnitude of changes differed among animals, arterial lactic acid reached a peak value within the first 2 hours at altitude, gradually declining thereafter, and, in most animals, it closely approached the control value during the eighth hour at altitude. Excess lactate changed in a similar manner (with no concomitant relief of arterial hypoxia and hypocapnia). The decline in lactic acid remains unexplained. Author

N64-18917 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
ENDOCRINE AND METABOLIC EFFECTS OF SHORT-DURATION HYPEROXIA
Henry B. Hale, Edgar W. Williams, John E. Anderson, and James P. Ellis, Jr. Feb. 1964 9 p refs
(SAM-TDR-64-6; AD-434424)

This investigation was concerned with the effects of breathing 100% oxygen (by mask) at 1 atm ambient pressure for 4 hr on sympathoadrenal, adrenocortical, and metabolic functions in healthy human subjects. Control determinations were made on the same subjects on a separate occasion by having the subjects breathe room air (by mask). Sympathoadrenal activity was appraised by means of urinary epinephrine and norepinephrine determinations; adrenocortical activity was appraised by means of plasma cortisol and urinary 17-hydroxycorticosteroid determinations; metabolic appraisal was made by means of urinary creatinine, urea, uric acid, phosphate, potassium, and sodium. Evidence of hyperoxia-induced adrenocortical and sympathoadrenal depression was found, with plasma cortisol concentration, as well as catecholamine excretion, falling below the control levels. Urine volume also was relatively low, as were urinary sodium and phosphate values. Mask discomfort was shown to be an obscuring factor, since it acted oppositely to hyperoxia in many respects. Author

N64-18918 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
CONSTRUCTION AND USE OF A SIMPLE, SELF-GUIDING CATHETER FOR RIGHT HEART AND PULMONARY ARTERY IMPLANTATION
William P. Fife Feb. 1964 7 p refs
(SAM-TDR-64-10; AD-434425)

A catheter has been developed that can be easily and rapidly implanted in the right heart or pulmonary artery. Fabricated from Tygon tubing, the catheter contains a thin section located 2 cm from the distal end. This results in a tip that follows the bloodstream without special manipulation. During implantation, its position is monitored by the use of a pressure transducer, thus eliminating the need for fluoroscopy. Since the catheter is self-guiding, it may be implanted with ease from such distal locations as the femoral vein. It can be used to inject substances directly into the heart or pulmonary artery, or to withdraw blood samples. It also can be used to make pressure recordings of high quality from these areas. Author

N64-18932 Industrial Biology Research and Testing Labs., Inc., Philadelphia, Pa.
CUTANEOUS TOXICITY EVALUATION OF AIR FORCE DEVELOPMENT MATERIALS – VI Technical Documentary Report No. 6, Oct. 1962–Jan. 1964

Morris V. Shelanski Wright-Patterson AFB, Ohio, Aerospace Med. Res. Lab., Feb. 1964 16 p refs
(Contract AF 33(657)-8900)
(AMRL-TDR-64-13; AD-435776) OTS: $0.50

Ten Air Force development materials were studied via the patch test method on laboratory animals to determine the primary irritant effect, gross sensitization index, and gross percutaneous toxicity of these materials. The patch test studies with rabbits indicated that three of the materials showed very mild primary irritant action. None of the materials produced any sensitization or gross systemic poisoning. Dermal reactions on rabbits were so mild that testing on humans was not precluded. The materials were, therefore, tested on human volunteers by the Shelanski repeated-insult patch test. Results of this test indicated that all of the materials were safe to use on contact with human skin. Author

N64-18966 Joint Publications Research Service, Washington, D.C.
PHYSIOLOGICAL MECHANISMS OF THE HUMAN ORGANISM AND METHODS OF STUDYING THEM
14 Apr. 1964 38 p refs Transl. into ENGLISH of 4 articles from Vopr. Kurortol. Fizioterapii i Lecheb. Fiz. Kul't. (Moscow) no. 6, 1963 p 481-487, p 510-526
(JPRS-24183; OTS-64-31072) OTS: $1.00

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1. PHYSIOLOGICAL MECHANISMS OF ACCLIMATIZATION AND HABITUATION OF THE HUMAN ORGANISM TO COLD A. D. Slonim p 1-10 refs

2. THE UTILIZATION OF HEAT-EMISSION MEASUREMENTS DURING SUDDEN COOLING, FOR EVALUATION OF THE CONDITION OF THERMOREGULATING MECHANISMS G. D. Latyshev p 11-20

3. HEAT EXCHANGE OF MAN IN AN AQUEOUS MEDIUM G. B. Smolyanskiy p 21-27 refs

4. UTILIZATION OF PROPER VALUES FOR ESTIMATION OF THE FUNCTIONAL CONDITION OF AN ORGANISM V. F. Shubin p 28-35 refs

N64-18967 Joint Publications Research Service, Washington, D.C.
X-RAY INJURIES
V. M. Stepanov and F. S. Golubkova 14 Apr. 1964 5 p refs Transl. into ENGLISH from Vestn. Khirurg. (Leningrad), v. 92, no. 2, Feb. 1964 p 132-133
(JPRS-24185; OTS-64-31074) OTS: $0.50

A brief discussion on the need for increased control in the use of X-irradiation during medical treatment of injuries is presented. P.V.E.

N64-18968 Joint Publications Research Service, Washington, D.C.
A STUDY OF THE MICROFLORA OF GAMMA-IRRADIATED PRODUCTS
F. S. Apt et al 14 Apr. 1964 8 p Transl. into ENGLISH from Mikrobiologiya (Moscow), v. 33, no. 1, Jan.-Feb. 1964 p 167-171
(JPRS-24187; OTS-64-31076) OTS: $0.50

The residual microflora of edible products—meat, fish, and green peas—irradiated with gamma radiation at doses from 600 to 1,500 kilorads are chiefly the coccal forms and yeasts. Cocci and yeast have been isolated from spoilage-bulged cans containing irradiated products. Under the effect of irradiation, some of the spontaneous product microflora change their morphological and biochemical properties. Author

N64-18969 Joint Publications Research Service, Washington, D.C.
DATA ON ACCUMULATION COEFFICIENTS OF P^{32}, S^{35}, Sr^{90}, Y^{91}, Cs^{137} AND Ce^{144} IN MARINE ORGANISMS
G. G. Polikarpov 16 Apr. 1964 28 p refs Transl. into ENGLISH from Tr. Sevastopol'sk. Biol. St. Akad. Nauk SSSR (Moscow), v. 14, 1961 p 314-328
(JPRS-24227; OTS-64-31088) OTS: $0.75

Data on the following are presented: the accumulation coefficients of six fission and controlled radioisotopes in different plants and animals of the Black Sea; the absence, within a wide range, of a relationship between these coefficients and the concentration of an isotope in an aqueous medium; the values of the accumulation coefficients under conditions when the isotope is introduced once and its concentration is constantly maintained at the same level; and changes in the accumulation coefficients of the most important fission products during detritus formation. It is felt that these results indicate that the Black Sea does not meet the requirements called for in an international site for the burial and neutralization of high-activity wastes from the atomic industry. R.T.K.

N64-18972 Joint Publications Research Service, Washington, D.C.
STUDIES OF PHYSIOLOGICAL REACTIONS TO IRRADIATION AND OTHER FACTORS, AND THE USE OF BIOTELEMETRY
22 Apr. 1964 52 p refs Transl. into ENGLISH of 7 articles from Byull. Eksptl. Biol. i Med. (Moscow), no. 2, 1964 p 29-40, 93-101, 104-107, and 117-121
(JPRS-24301; OTS-64-31131) OTS: $1.50

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1. FUNCTIONAL DISTURBANCES OF THE LIVER OF STRONTIUM-90 AFFECTED DOGS A. A. Yusupov, A. I. Nevskaya, and N. I. Ovdiyenko p 1-8 refs

2. DYNAMICS OF WHITE BLOOD RESPONSE TO IRRADIATION I. K. Petrovich and Yu. I. Moskalev p 9-16 refs

3. EFFECT OF SINGLE LOCAL IRRADIATION ON THE PERIPHERAL BLOOD VESSELS AND THEIR REACTION TO THE ADMINISTRATION OF ADRENALIN O. V. Mikhaylova p 17-22 refs

4. CHANGES IN THE IMMUNOLOGICAL CONDITION OF THE ORGANISM DURING THE ACTION OF CARCINOGENIC CHEMICAL AGENTS D. D. Shapiro and I. Ya. Getmants p 23-29 refs

5. EFFECT OF ULTRA-HIGH FREQUENCY MAGNETIC FIELD ON THE ELECTRIC ACTIVITY OF THE NEURONALLY ISOLATED CEREBRAL CORTEX BAND Yu. A. Kholodov p 30-36 refs

6. POSSIBILITY OF FORMATION OF ANTI-ANTIBODIES AND THEIR EFFECT ON THE SURVIVAL TIME OF SKIN HOMOTRANSPLANTS L. M. Okuneva p 37-42 refs

7. TRANSISTORIZED DEVICE FOR RADIOTELEMETRIC RECORDING OF THE FREQUENCY OF CARDIAC CONTRACTIONS, RESPIRATION AND MOVEMENTS R. V. Unzhin and V. V. Rozenblat p 43-49 refs

N64-18975 Joint Publications Research Service, Washington, D.C.
PHOTOSYNTHESIZING BACTERIA
Ye. N. Kondrat'yeva 23 Apr. 1964 143 p refs Transl. into ENGLISH of the foreword, chapters 1-5, and the bibliog. from the publ. "Fotosinteziruyuschiye Bakterii" Moscow, 1963 p 3-111 and 265-274
(JPRS-24319; OTS-64-31140) OTS: $2.75

This report deals with purple sulfur, purple nonsulfur, and green sulfur photosynthesizing bacteria. The following topics are discussed: (1) the distribution and role of photosynthesizing bacteria in nature; (2) methods of isolating and cultivating these bacteria; and (3) the morphology, chemical composition, and pigments of the bacteria. I.v.L.

N64-18976 Joint Publications Research Service, Washington, D.C.
PATHOGENESIS AND TREATMENT OF BURN SICKNESS
G. D. Vilyavin and O. V. Shumova 24 Apr. 1964 61 p refs Transl. into ENGLISH of portions of book "Patogenez i Lesheniye Ozhogovoy Bolezni" Moscow, 1963 p 3–34, 229–253, and 275–276
(JPRS-24338; OTS-64-31145) OTS: $1.50

The pathogenetic mechanisms in the development of burn sickness were investigated for the purpose of developing the most rational methods of treating burn patients. Included in the procedure were the following investigations: (1) an extended study of patients with regard to laboratory–clinical hematological investigations, and biochemical analyses; (2) the role of infection in the pathogenesis and clinical course of burn sickness; (3) the reflex vascular reactions by the plethysmographic method; (4) morphological and neurohistological research on the peripheral and central nervous system as well as on the condition of synapses in extensive burns; and (5) hemodynamics and the permeability of capillaries at the site of lesions, in individual organs and in the central nervous system, using the vital microscopy method. The overall treatment of burn sickness and burn shock that was developed includes: (1) sparing the traumatic method of initial treatment; (2) procaine hydrochloride block and dressings of an oily-balsamic emulsion that remains in place for a prolonged period; (3) medicine-induced sleep; (4) local hypothermia; (5) the extensive use of skin autoplasty and homoplasty; and (6) the use of blood transfusions in all stages. Simultaneous with this treatment, modern effective methods of etiotropic, replacement, and stimulant therapy; plasma and blood-substitute transfusions; multivitamins; high-caloric diets rich in protein and vitamins; and antibiotics of different spectrum action were used. I.v.L.

N64-18978 Joint Publications Research Service, Washington, D.C.
METACHROMATIC REACTION OF NUCLEIC ACIDS (DNA AND RNA), NATIVE AND IRRADIATED BY ULTRASOUND
F. I. Braginskaya and I. Ye. El'piner 27 Apr. 1964 24 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 9, no. 1, 1964 p 40–47
(JPRS-24353; OTS-64-31159) OTS: $0.75

As a result of treatment with ultrasound a degradation of nucleic acids occurs in the presence of oxygen or argon, accompanied by a destruction of nitrogen bases. When DNA is irradiated in the presence of argon, derivatives of nitrogen bases arise that fluoresce blue in the ultraviolet. DNA, while interacting with toluidine blue, displaces the absorption peak of this dye toward longer wavelengths. A similar shift of the dye peak was observed when toluidine blue interacts with RNA at sufficiently high ratios of nucleic acid. With a decline in the relative concentration, RNA produces a displacement of the dye peak toward shorter wavelengths. When solutions of DNA and RNA were irradiated in the presence of oxygen and argon, there appeared to be a disruption of the helical structure of nucleic acids with a subsequent oxidation of nitrogen bases. Results of the thermal denaturation of DNA and RNA are also presented. R.T.K.

N64-18980 Joint Publications Research Service, Washington, D.C.
THE STUDY OF BIRD FLIGHT
V. E. Yakobi 27 Apr. 1964 12 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 9, no. 1, 1964 p 118–121
(JPRS-24357; OTS-64-31161) OTS: $0.50

The experiments have demonstrated the possibility of utilization of the aerodynamical vane and silk-thread methods to study directly the airflow direction on a wing of a flying bird. Using this method, it was established that the vortexes are moving away from the wing of a flying bird in the upper and lower points of the wing stroke, which confirms the physical hypothesis laid down by V. V. Golubev as a basis of his flapping-wing theory. The direction of air fluxes about the wing surface corresponds to the direction of barbs of the flapping and covering feathers on the lower and upper surfaces of the wing. Author

N64-18987 Bureau of Mines, College Park, Md.
LEACHING COPPER SULFIDE MINERALS WITH SELECTED AUTOTROPIC BACTERIA
Joseph A. Sutton and John D. Corrick 1964 27 p refs
(BMRI-6423)

The microbial dissolution of iron and copper from sulfide minerals pyrite, chalcopyrite, chalcocite, covellite, and bornite is described. Chemical criteria to evaluate microorganism activity on these minerals were changes in pH, ferric iron produced, and oxygen consumption. When a ferrous sulfate nutrient solution was percolated over small portions of copper sulfide minerals for 56 days, the iron-oxidizing bacteria *Ferrobacillus ferrooxidans and Thiobacillus ferroxidans* brought about the dissolution of 23.7% of the copper from chalcocite, 56.3% of the copper from covellite, and 29.8% of the copper from bornite by the microbial production of ferric sulfate, which reacted with these minerals. Pure strains of the iron-oxidizing bacteria act as catalysts to the ferrous iron being oxidized by the oxygen of a system containing pyrite and chalcopyrite. When a nutrient solution was percolated over pyrite for 70 days, the ferric iron produced by the iron-oxidizing bacteria was 112 to 120 times greater than that produced atmospherically. Author

N64-19015* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASUREMENT OF THE HEARTBEAT OF BIRD EMBRYOS WITH A MICRO-METEORITE TRANSDUCER Technology Utilization Report
Vernon L. Rogallo Washington, NASA, Apr. 1964 16 p
(NASA-SP-5007) OTS: $0.50

A new ultrasensitive momentum transducer has been successfully adapted as a ballistocardiograph to measure the heart beat of avian embryos. Experiments have demonstrated that life can be detected as early as 4 days in the incubation period and monitored to maturity without damage to the avian embryo. Changes in heart-beat rate and intensity resulting from temperature changes, or other external stimuli, were readily detected by the instrument. The technique appears to open new avenues of investigation for application in such areas as vaccine production and drug research. Author

N64-19035 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
THE EFFECTS OF RADIATION AND RADIOISOTOPES ON THE LIFE PROCESSES. AN ANNOTATED BIBLIOGRAPHY, BOOK I
Charlie M. Pierce, comp. Sep. 1963 744 p refs
(TID-3098, Book 1) OTS: $15.00 for books 1–3

A total of 11,944 annotated references to report and published literature concerning the effects of radiation on biological systems is presented. The references are primarily categorized by type of organism. An author and a permuted title subject index are provided. Author

N64-19036 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
THE EFFECTS OF RADIATION AND RADIOISOTOPES ON THE LIFE PROCESSES. AN ANNOTATED BIBLIOGRAPHY, BOOK 2
Charlie M. Pierce, comp. Sep. 1963 751 p refs For abstract see N64-19035 11-16
(TID-3098, Book 2) OTS: $15.00 for books 1-3

N64-19059 Joint Publications Research Service, Washington, D.C.
REPORTS ON BIOCHEMISTRY FROM THE UKRAINIAN SSR
13 Apr. 1964 45 p refs Transl. into ENGLISH of 3 articles from Ukr. Biokhim. Zh. (Kiev), v. 36, no. 1, 1964 p 14-20, 22-31, 132-155
(JPRS-24164; OTS-64-31065) OTS: $1.25

CONTENTS:
1. INCORPORATION OF RADIOMETHIONINE IN THE PROTEIN FRACTIONS OF BLOOD SERUM UNDER THE EFFECT OF X-RAY IRRADIATION AND THIOPHOSPHAMIDE I. V. Savitskiy and V. G. Zelinskiy p 1-8 refs
2. RUPTURE OF DISULFIDE BONDS OF FIBRINOGEN BY CYSTEINE A. K. Khomenko and V. A. Belitser p 9-18 refs
3. SYNTHESIS AND TRANSFORMATION OF AMINO ACIDS AND OTHER ORGANIC COMPOUNDS BY THE EFFECT OF RADIATION AND OTHER TYPES OF ENERGY M. A. Kolomiychenko p 19-42 refs

N64-19086 Hiroshima U. (Japan) School of Medicine
MECHANISMS OF SMOOTH MUSCLE RELAXATION THROUGH THE ANODAL CURRENT STIMULATION Final Report No. 2, 15 Jun. 1962-14 Jun. 1963
Hiroshi Irisawa Washington, Army Res. and Develop. Group (9852), 1963 36 p refs
(Contract DA-92-557-FEC-34980)
(AD-409502)

Action potential of the ureter smooth muscle shows a slow plateau phase, which indicates that a single cell is responsible for the plateau formation. The effect of repetitive stimulation on this muscle was studied, and it was found that the refractory period of the ureter smooth muscle cell was very long compared to other smooth muscles. The effect of sodium deficiency on the pattern of action potential has also been studied, and the results indicated that the action potential of the smooth muscle of the ureter can be satisfactorily explained from the basis of sodium hypothesis. Continuation of the histological works has been made on the fine structure of the invertebrate muscle. The conduction of excitation in the stomatopod heart is definitely different from that of the mammalian smooth muscles, where muscle-to-muscle conduction can be considered. Author

N64-19091 Brookhaven National Lab., Upton, N.Y.
COBALT-60 BULK GRAIN IRRADIATOR Study Report
B. Manowitz, O. A. Kuhl, and L. Galanter 30 Jun. 1963 71 p Prepared by Vitro Eng. Co. for Brookhaven
(Contract AT(30-2)-GEN-16)
(BNL 810(T-312)) OTS: $1.50

This is a study to conceive, evaluate, review, and estimate costs for a number of suitable designs for a cobalt-60 bulk grain irradiator, select a preferred type, and establish required criteria for future detail design and construction of the selected concept. Three irradiator concepts are described. The irradiators are sized to function as a pilot plant in an agricultural experiment station. Particular attention is given to scale-up capability, so that the same performance characteristics can be obtained for commercial utilization, without penalty to the usefulness of the irradiator as an experimental tool. A single concept, designated as the continuous-grid source concept and approved by USDA, was selected because of its high efficiency, exceptional versatility, acceptable cost, ease of maintenance, good reliability, and inherent simplicity. Author

N64-19097 California U., Livermore. Lawrence Radiation Lab.
CALCULATION OF RADIOACTIVE IODINE CONCENTRATIONS IN MILK AND HUMAN THYROID AS A RESULT OF NUCLEAR EXPLOSIONS
Ralph A. James 14 Feb. 1964 23 p refs
(Contract W-7405-ENG-48)
(UCRL-7716) OTS: $0.50

The production and distribution of radioactive iodine by nuclear explosions are discussed. Equations and graphs are presented by which the levels of I^{131} and I^{133} corresponding to the Federal Radiation Council (FRC) guide can be determined. The fallout level, intake by cows, concentration in milk, and content of the human thyroid are considered. The maximum concentration in milk as the result of a single event corresponding to the FRC guide is approximately 2,800 picocuries (pCi) per liter. Author

N64-19150* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PITFALL OF LOW SPECIFIC ACTIVITY RADIOACTIVE THYMIDINE
Robert B. Painter and Ronald E. Rasmussen Repr. from Nature, v. 201, no. 4917, 25 Jan. 1963 3 p refs

The effect of low-specific-activity radioactive thymidine (tritiated thymidine) on the observation of the results of the action of X-irradiation on the synthesis of DNA in cultured mammalian cells was investigated. Results indicate that thymidine masks some of the effects of X-irradiation on the DNA synthesizing system by detracting from the part of rate depression contributed by the steep component of the X-ray dose-response curve. However, guanine labeled with carbon-14, a low-specific-activity radioactive substance, apparently does not affect DNA synthesis rate. These results illustrate that radioisotopic compounds of low specific activity must be checked to assure that the necessarily high concentrations of metabolites are not affecting the system under study. I.v.L.

N64-19151* Florida State U., Tallahassee Inst. for Space Biosciences
ABIOTIC PRODUCTION OF PRIMITIVE PROTEIN AND FORMED MICROPARTICLES
Sidney W. Fox and Shuhei Yuyama Repr. from the Ann. N.Y. Acad. Sci., v. 108, article 2, 29 Jun. 1963 p 487-494 refs Presented in part at the Symp. on Extraterrestrial Biochem. and Biol., Am. Assoc. for the Advancement of Sci. Meeting, Denver, 27 Dec. 1961 Previously published as a preprint paper; see N62-15697 15-16
(NASA Grant NsG-173-62; NIH Grant C-3971(04))

Thermal copolymerization of simple combinations of amino acids can be effected simultaneously. This copolymerization is aided by phosphoric acid, polyphosphoric acid, or adenosine triphosphate. The polyamino acids obtained are referred to as protenoids because of molecular weight and qualitative composition, but they have many properties in common with proteins. Two of the most interesting properties of these acids are those of catalytic activity and morphogenicity. The catalytically active powerful macromolecules are formed under almost dry conditions by heating, and this activity is later lost also by heating, but the loss occurs in aqueous solution. The kind of morphogenicity depends upon intrusion of water into the system. The fact that intrusion of water is required for the formation of spherules demands a relative absence of water from the system before the macromolecules are organized into supramolecular entities. These entities are of interest as precell models. They and their derivatives are of interest also for their morphological similarity to some microfossils and to formed elements found in meteorites. I.v.L.

N64-19152* Atomic Energy Commission, Washington, D.C.
DETERMINATION OF PRECURSOR ORDER AND PARTICULAR WEIGHTING FUNCTIONS FROM KINETIC DATA
James S. Beck (Minn. U.) and Aldo Rescigno (Calif. U.) Repr. from J. Theoret. Biol. v. 6, 1964 p 1–12 refs
(NASA Order R-104)

The analysis of kinetic data from biochemical and physiological tracer experiments has been advanced theoretically and practically by the interpretation of the output data as point values of a function resulting from the convolution (the integral operation $\int_0^t f(r)g(t-r)dr$) of the input function with an unknown weighting function. This weighting function characterizes the system; most notably, it indicates the number of compartments or precursor order in certain classes of systems. A simple method of determining precursor order from data relating input and output to time is presented. An artificial example and data from a biochemical experiment are analyzed with these relations. The problem of selecting a limit is discussed and related to the general characteristics of models and synthesis of models. Author

N64-19184 Dynamic Science Corp., South Pasadena, Calif.
HUMAN BLOOD IN THE SPACE ENVIRONMENT – IN VITRO STUDIES IN EARTH ORBIT
Curtis E. Miller, Allan L. Louderback, and John B. Opfell Los Angeles, Calif., SSD, Jan. 1964 83 p refs
(Contract AF 04(695)-93)
(SSD-TDR-64-1; AD-434086)

The effect of space environment on human blood was investigated in vitro, using blood in acid–citrate–dextrose solution. Special thermal-insulation units to hold the blood specimens were designed, and were flown as part of a recoverable earth-orbiting satellite. Diffusion through the red-cell membrane, glucose metabolism, antigen and immunological properties, and plasma-protein composition were the blood properties studied. Critical factors were temperature and acceleration–vibration during launch and recovery. Temperature was controlled by a thermal-insulation system. Acceleration–vibration had no significant effect through experiments using a human centrifuge to simulate launch acceleration and vibration. The results of three flights showed that there was no significant effect of the space environment on the blood properties studied, except that the rate of diffusion of potassium from the red-blood cell to the plasma may be lower in the space environment than on the earth's surface, and the distribution of the plasma proteins appears to be affected by the space environment, particularly the beta-globulin fraction of the proteins. Author

N64-19220 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE BIOLOGICAL ACTION OF HIGH ENERGY FAST NEUTRONS AND PROTONS
Yu. I. Moskalev, I. K. Petrovich, and V. N. Strel'tsova 23 Jan. 1964 31 p refs Transl. into ENGLISH from the Symp. proc. "Biol. Deistviye Bystrykh Neytronov i Protonov Vysokikh Energiy" (USSR), 7–11 Oct. 1963 p 1–33
(FTD-TT-63-1049/1+2+4; AD-433529)

The results are presented of experiments which compared the effect of fast neutrons and protons on life span, peripheral blood, incidence, and rate of appearance of tumors in rats and their dependence on dose and period of observation. In general it was found that, in cases of comparatively low levels of radiation, neoplasms of the endocrine glands, sexual organs, and mammary glands primarily occur in both females and males. With an increase in the level of radiation, the incidence of tumors on the gastrointestinal tract, sarcoma of the subcutaneous tissue, tumors of the kidneys, etc., increased in the rats, along with neoplasms of the endocrine organs. It was found that the type of radiation dose did not substantially affect the qualitative characteristics of the tumor spectrum (i.e., in animals irradiated with fast neutrons and protons, the tumors of the same type occur). It is noted, however, that on irradiation with neutrons, neoplasms occur at smaller doses of radiation (approximately 3 to 5 times). P.V.E.

N64-19236 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
THE EFFECTS OF RADIATION AND RADIOISOTOPES ON THE LIFE PROCESSES, AN ANNOTATED BIBLIOGRAPHY (INDEX)
Charlie M. Pierce, comp. Sep. 1963 352 p refs
(TID-3098(Index)) OTS: $15.00 for books 1–3

This volume is an author and a permuted title subject index. Author

N64-19296 European Atomic Energy Community, Brussels (Belgium)
BONE MARROW TRANSPLANTATION AFTER WHOLE-BODY IRRADIATION. AN EXPERIMENTAL STUDY IN THE RAT
H. Balner (Ph. D. Thesis, Amsterdam U.) 1963 127 p refs Work done in conjunction with Toegepast Natuurw. Onderzoek
(Contract EURATOM 004-59-12 BIAN)
(EUR-484e) Available from Belgian Am. Bank and Trust Co., N.Y., acc. no. 121.86 150 Belg. Fr.

Rats were treated with homologous bone marrow following high sublethal and lethal radiation doses. The majority of the animals survived beyond 4 weeks after irradiation with a functioning donor-type hemopoietic tissue. There was no evidence of a so-called "median-lethal-dose-effect" (MLD-effect). Secondary disease occurred during the second and third month following irradiation and homologous bone-marrow therapy. Morbidity and mortality were variable but generally rather low, respectively about 30% and 15%. The clinical and pathological findings were reminiscent of those described for mice with secondary disease except that colitis and diarrhea were not observed. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-18529 Joint Publications Research Service, Washington, D.C.
VACUUM TREATMENT OF METALS
13 Apr. 1964 59 p refs Transl. into ENGLISH of 4 Symp. articles from the book "Primenenie Vakuuma v Metallurgii" Moscow, Publishing House of Acad. of Sci., 1963 p 14–21, 22–26, 61–64, 237–248
(JPRS-24170; OTS-64-31069) OTS: $1.00

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N64-18530 Joint Publications Research Service, Washington, D.C.
MELTING AND POURING OF RUST-RESISTANT TOOL STEELS IN VACUUM INDUCTION FURNACES
K. K. Chuprin, V. P. Grechin, and A. I. Drobyshev *In its* Vacuum Treatment of Metals 13 Apr. 1964 p 1–9 refs (See N64-18529 11-17) OTS: $1.00

The melting and pouring of steel alloyed with beryllium in vacuum induction furnaces are discussed. It was found that in working with vacuums up to 1 × 10^{-3} mm mercury, chromium, nickel, tungsten, and cobalt are assimilated into the steel mixture 100%, vanadium 90%, beryllium 95% (when introduced either as Ni-Be alloy or as metallic beryllium) with a content of oxygen in the initial iron not higher than 0.005%, and carbon 80% at a 1,600° C temperature. The use of vacuumed ferrochrome instead of metallic chromium for alloying of vacuum steel did not affect the properties of the steel. After melting and pouring steel (brands VNS-1 and EI-928) in vacuum induction furnaces, it was found that the gas content decreases when compared to that found in steel prepared in the usual way: oxygen by 4 to 5 times, hydrogen by 6 to 7 times, and nitrogen by 1.5 to 2 times; the impurities content of bismuth was lowered by 40%, arsenic by 45%, lead by 60%, tin by 55%, and copper by 75%. It was also found that the steels melted and poured in a vacuum possessed higher plastic properties. P.V.E.

N64-18531 Joint Publications Research Service, Washington, D.C.
TECHNOLOGY OF PRECISION CASTING OF HEAT-RESISTING ALLOYS IN VACUUM
N. D. Potashnikov *In its* Vacuum Treatment of Metals 13 Apr. 1964 p 10–15 (See N64-18529 11-17) OTS: $1.00

Construction of a high-frequency induction vacuum furnace with a 16-kg capacity is discussed. The installation was designed to insure the production of quality castings without the presence of oxide blisters. In melting and casting in vacuum, carbon monoxide and irrevocable losses decrease significantly. Return metal is more completely used, since it can be used in the charge as though it were fresh material. P.V.E.

N64-18533 Joint Publications Research Service, Washington, D.C.
IMPROVING HEAT TREATMENT OF MAGNETICALLY SOFT ALLOYS IN A VACUUM
N. I. Lapkin *In its* Vacuum Treatment of Metals 13 Apr. 1964 p 21–36 refs (See N64-18529 11-17) OTS: $1.00

Ways of improving heat treatment of magnetically soft alloys are discussed. In particular, the following are discussed: (1) improvement of construction of vacuum furnaces and installations—inertial vacuum furnaces, cupola vacuum furnaces, noninertial deep-vacuum furnaces, multizone semicontinuous deep-vacuum furnaces; (2) increase of magnetic properties of electrotechnical steels upon annealing under deep vacuum, and (3) heat treatment of iron–nickel alloys. P.V.E.

N64-18535 Boeing Co., Seattle, Wash.
RELIABILITY AND ENVIRONMENTAL ENGINEERING
Leslie W. Ball *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 1–7 (See N64-18534 11-33)

This paper outlines the technical and management steps that must be taken to exploit the potential contributions of environmental engineering to reliability and overall cost effectiveness. Author

N64-18564 American Machine and Foundry Co., Alexandria, Va.
DESPOSITION FORMING PROCESSES FOR AEROSPACE STRUCTURES Final Report, 31 Jul. 1961-31 Oct. 1963
M. E. Browning, H. W. Leavenworth, W. H. Webster, Jr., and F. J. Dunkerley Wright-Patterson AFB, Ohio, AF Mater. Lab. Jan. 1964 140 p refs
(Contract AF 33(657)-7016)
(ML-TDR-64-26; AD-433559)

Nine deposition processes were reviewed with appropriate screening tests to determine their applicability for development as deposition-forming processes. Electroforming, chemical vapor deposition, and an electrocombination process were selected. A Cb-W alloy was deposited by the chemical vapor deposition method, but formed structures could not be successfully removed from the mandrel. Nickel containing a dispersion-hardening phase was deposited by the electrocombination method; further scaleup development is indicated to exploit the promising results of using this unique method of fabricating aerospace components from dispersion-hardened metals. Electroforming was proven to have very promising potential as a practical manufacturing method for producing components typical of aerospace designs from difficult-to-fabricate alloys; this was achieved by developing a complete cobalt-base quaternary electroforming system and the production of several complex free standing shapes to demonstrate its applicability. Author

N64-18576 Wah Chang Corp., Albany, Ore. Manufacturing Technology Lab.
TANTALUM EXTRUSION PROGRAM, PHASE III Interim Technical Engineering Report No. 5, 25 Jun.-25 Sep. 1962
M. D. Mc Nabb [1962] 58 p refs
(Contract AF 33(600)-42396)
(ASD-IR-7-783(3); AD-285316)

Modification in the induction furnace, which considerably improved the argon protective atmosphere, resulted in significant improvement in the extrusion surfaces. Cladding the Ta-10W billets in molybdenum sheet lowered extrusion pressures to two-thirds those normally obtained. The use of a molybdenum nose plug on the Ta-10W billets proved to be effective in reducing upset pressures and permitted the extrusion of the target "T" section at 2700° F. Billet fabrication history appears to have little effect on extrusion characteristics or quality. Author

N64-18611 Ohio State U. Research Foundation, Columbus
NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS REINFORCED PLASTIC MISSILE CASES Quarterly Status Report No. 4, 29 Mar.-28 Jun. 1962
Merle Rhoten, Jay P. Mitchell, and Robert C. Mc Master Dec. 1963 24 p refs
(Contract DA-33-019-ORD-3670)
(WAL-TR-142.5/2-3; AD-433003)

This report describes the use of a unique X-ray television imaging system for the inspection of fiber-glass-reinforced plastic materials. Contrast and resolution capabilities of the system are described, and representative photographs of images are included. Author

N64-18612 Ohio State U. Research Foundation, Columbus
NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS REINFORCED PLASTIC MISSILE CASES [Quarterly Report No. 5, 29 Jun.-18 Sep. 1962]
Merle Rhoten, Jay P. Mitchell, and Robert C. Mc Master Watertown Arsenal, Mass., Dec. 1963 8 p
(Contract DA-33-019-ORD-3670)
(WAL-TR-142.5/2-4; AD-433219)

The X-ray television imaging system is to be modified to operate in conjunction with a scan-conversion image storage system. Various available scan-conversion equipment has been studied, and specifications for the purchase of scan-conversion and image storage equipment have been prepared. Research with slow-scan television equipment is being conducted, and video-signal storage using audiomagnetic tape recording techniques have been accomplished. Author

N64-18613 Ohio State U. Research Foundation, Columbus
NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS REINFORCED PLASTIC MISSILE CASES AND OTHER STRUCTURAL MATERIALS Quarterly Technical Report No. 6 [29 Sep.-28 Dec. 1962]
Robert C. Mc Master, Merle L. Rhoten, and Jay P. Mitchell Watertown Arsenal, Mass., 1 Feb. 1963 23 p refs
(Contract DA-33-019-ORD-3670)
(WAL-TR-142.5/2-6; AD-430905)

A slow-scan television system is being used to produce X-ray images. A standard audiofrequency magnetic tape recorder has been used to record the slow-scan video signal with considerable success. This initial work proves the applicability of using a slow-scan television system in conjunction with an audiofrequency recorder to provide an economical means of recording television X-ray images. The use of the television X-ray equipment as a means of inspecting fiber glass missile case materials is evaluated. The system appears to be an accurate method of visualizing discontinuities that offer a density difference. For the inspection of weldments in aluminum on the order of 1 inch in thickness, a 2-inch television camera is under construction. This camera is being designed and constructed to accommodate a 2-inch X-ray-sensing television camera tube. Author

N64-18614 Ohio State U. Research Foundation, Columbus
NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS REINFORCED PLASTIC MISSILE CASES AND OTHER STRUCTURAL MATERIALS Seventh Quarterly Status Report [29 Dec. 1962-28 Mar. 1963]
Jay P. Mitchell, Merle L. Rhoten, and Robert C. Mc Master Watertown Arsenal, Mass., May 1963 29 p refs
(Contract DA-33-019-ORD-3670)
(WAL-TR-142.5/2-7; AD-430568)

Advanced development work on X-ray television imaging systems was carried out to improve their sensitivity, performance, and to extend their usefulness by use of various storage media. X-ray imaging tests of a slow-scan television camera chain indicated that only 15% of the X-radiation intensity required for the standard 30-frame-per-second camera chain was needed to produce comparative X-ray images at 1/4 frame per second. Tests of response to X-radiation of four X-ray-sensitive camera tubes having target thicknesses for 8 to 45 microns and using slow-scan operation indicated that the tube having an 8-micron thickness of selenium target was most sensitive. An electronic switching device was designed and constructed to provide more effective control of intermittent-scan operation of the standard television image enlargement system. Author

N64-18615 Ohio State U. Research Foundation, Columbus
NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS REINFORCED PLASTIC MISSILE CASES AND OTHER STRUCTURAL MATERIALS Quarterly Technical Report No. 8 [29 Mar.-28 Jun. 1963]
Jay P. Mitchell, Merle L. Rhoten, and Robert C. Mc Master Watertown Arsenal, Mass., Aug. 1963 46 p refs
(Contract DA-33-019-ORD-3670)
(WAL-TR-142.5/2-7a; AD-433002)

An audiofrequency tape recorder was utilized to record slow-scan television X-ray images on 1/4-in.-wide magnetic tape. A keyed clamping circuit was constructed and added to the recorder playback amplifier circuit to provide improved quality to the recorded television signals. Recording tests have indicated that 0.001-in. detail resolution could be visualized in the playback image. The television X-ray imaging system was used to determine the feasibility of monitoring a fusion welding process while the weld material was still in a molten state. The imaging results indicated that porosity and crack propagation could be detected in 3/8-in.-thick aluminum alloy. Author

N64-18639 Bureau of Mines, College Park, Md.
RECOVERY OF ZINC FROM GALVANIZERS DROSS AND ZINC-BASE DIE-CAST SCRAP BY FILTRATION
J. A. Ruppert and P. M. Sullivan 1964 23 p refs
(BM-RI-6417)

A process was developed on a laboratory scale in which iron contained in galvanizer zinc dross and aluminum contained in scrap zinc die-cast alloy were removed simultaneously. Melting both types of scrap together in the proper proportions resulted in formation of solid intermetallic Fe_2Al_5, which was readily removed from the melt by filtration and centrifugation. Recovery was 87 and 92 percent of the available zinc. Refined filtrate contained 0.02-percent iron and 0.20-percent

aluminum. Aluminum content was further reduced to less than 0.01 percent by fluxing with zinc chloride. Author

N64-18645 Army Missile Command, Huntsville, Ala.
INSTANTANEOUS TEMPERATURES ON CONTACT SURFACES DUE TO FRICTION
B. P. Stoyukhin 2 Mar. 1964 19 p refs Transl. into ENGLISH from Nauchn. Dok. Vysshei Shkoly, Mashinostr. i Priborostr. (Moscow), no. 4 1958 p 73–81
(RSIC-142; AD-434549)

As a result of the investigations performed, a new dependence was obtained for determining the temperature of an instantaneous point source of heat that occurs on the small actual contact made during the sliding of two bodies relative to each other. A formula was derived that allows the determination of the temperature fields that are dependent on the temperature of the flash in the center of a heat source during instantaneous contact. Another formula is derived that makes it possible to determine the temperature, at any point on the contact surface, between two bodies of the same material and to plot the field of temperatures caused by a continuously active point source. E.W.

N64-18656 Rock Island Arsenal, Ill.
RUST REMOVING CORROSION PREVENTIVES – LITERATURE REPORT
Bernard J. Bornong 27 Aug. 1963 42 p refs
(RIA 63-2762; AD-432503) OTS: $1.25

A survey of the literature on rust removal and prevention was conducted to (1) determine the status of materials used for these purposes, and (2) consider the feasibility of developing a readily removable oil or solvent-soluble combination rust remover and preventive. At present, no combination product of this type is available that is a completely effective rust remover and preventive. Development of such a product is recommended. Several areas for intensive study, which may aid in this development, are suggested. Author

N64-18674 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SELF-ADJUSTING SYSTEM OF PROGRAM CONTROL OF METAL-CUTTING MACHINES
M. I. Breydo, M. L. Bykhovskiy, and A. E. Kobrinskii 15 Jul. 1963 18 p refs Transl. into ENGLISH from the book "Avtomatizatsiya Protsessov Mashinostroyeniya, v. 1: Obshchiye Voprosy i Sredstva Avtomatizatsii", Moscow, Izd. AN SSSR, 1962 p 289–298
(FTD-MT-63-64/1+2; AD-434961)

A self-adjusting system of programed control for a milling machine is described. All of the designs presented are built in reference to a one-coordinate system of control, but they can be generalized to apply to a system of control having several coordinates. R.T.K.

N64-18687 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DEFORMATION OF METAL IN AN ULTRASONIC FIELD
V. P. Severdenko and V. V. Klubovich 27 Dec. 1963 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 5, no. 1, 1961 p 15–16
(FTD-MT-63-161; AD-434978)

The influence of ultrasound on the plastic properties of metals was investigated, using an aluminum cylinder as a test specimen. Results indicate that ultrasonic oscillations change the conditions of metal flow in the deformed volume, and that the magnitude of the forces of contact friction and the magnitude of stress, necessary for the plastic flow of the metal, are decreased. I.v.L.

N64-18701 SKF Ind., Inc., King of Prussia, Pa. Research Lab.
INFLUENCE OF LUBRICATION ON ENDURANCE OF ROLLING CONTACTS Progress Report No. 7, 22 Mar. 1963–22 Jun. 1963
T. Tallian, Y. P. Chiu, and E. F. Brady [1963] 26 p refs
(Contract NOw-61-0716-c)
(AL63TO18; AD-417518)

Conductivity tests were conducted at low and high speeds in order to determine speeds, loads, and viscosity parameters for conditions of no film and essentially complete film lubrication, respectively, at the ball-to-ball contacts in a rolling four-ball test configuration. Data from these tests are still in the process of interpretation. The dynamic two-ball tester, designed to provide X-ray measurements of lubricant film thickness and contact profiles in a two-ball rolling contact, is described. Details of the X-ray mechanism, drive system spindles, fabrication and alignment procedure, the hydraulic system, and the electrical control system are given. Author

N64-18705 Silicon Transistor Corp., Carle Place, N.Y.
PRODUCTION ENGINEERING MEASURE TO INCREASE THE RELIABILITY OF THE TRANSISTOR TYPE 2N2034 Quarterly Progress Report No. 2, 1 Oct–31 Dec. 1963
J. Cocking, J. Courier, F. Des Roches, D. Hughes, and E. Martin 1963 53 p
(Contract DA-36-039-AMC-01482(E))
(AD-433476)

The current program status includes: (1) The procedure chosen for cleaning the surface of the silicon wafers, prior to the deposition operation, so that flat and nondistorted emitter and collector junctions can be obtained, consists of hand scrubbing the wafers with cotton swabs, using freon as the cleaning agent. (2) The metal etch-resist procedure on lapped wafers has been selected as the best procedure for the mesa delineation. This procedure provided a favorable I_{EBO} test yield, at the pellet test area, on the initial lots. (3) Certain basic problems have been found in using the scriber on the solder-dipped wafer, and an alternate procedure is being investigated. This procedure consists of sawing the wafers into pellets by use of diamond blades ganged on a single shaft, with the blades properly spaced to allow cutting along the paths between the pellets. (4) The use of nickel-plated headers and contact clips has been completely introduced into the production line of all types of transistors. (5) The alkaline electroetch procedure, using mounting racks, was selected as the best final-etch procedure. (6) The necessary welding conditions have been established to reproduce consistently a reliable hermetic seal. (7) It is concluded that nickel header and alkaline etch produce a much more stable device than the gold header and acid etch. I.v.L.

N64-18738 Radio Corp. of America, Somerville, N.J. Semiconductor and Materials Div.
PRODUCTION ENGINEERING MEASURE ON 2N1708 SILICON PLANAR EPITAXIAL TRANSISTOR, VOLUME I Final Report, 1 May 1962–30 Nov. 1963
G. F. Granger [1963] 160 p
(Contract DA-36-039-SC-86729)
(AD-435114)

A production run was made to demonstrate the reliability achieved as a result of improvements incorporated into the processing. A summary of the work performed in each of the major processing areas to effect the improvement is described in this report. A program of life testing, analysis of existing life-test data, and failure analysis was performed concurrently with the work in the processing area. This program included accelerated testing on both storage and operating life tests, which lead to the establishment of acceleration curves, the

analysis of results on extended life tests, the analysis of failures, and a study of the effect of aging. A discussion is included on the use of acceleration curves and the proposed electrical specification established for the improved device. Author

N64-18739 Radio Corp. of America, Somerville, N.J. Semiconductor and Materials Div.
OPERATING SPECIFICATIONS FOR PRODUCTION ENGINEERING MEASURE ON 2N1708 SILICON PLANAR EPITAXIAL TRANSISTOR, VOLUME II Final Report
G. Granger, P. Grenier and W. Keating [1963] 57 p
(Contract DA-36-039-SC-86729)
(AD-435115)

The current status of the following areas is presented: (1) stem assembly; (2) crystal and substrate preparation; (3) epitaxial-layer preparation; (4) oxide and surface passivation; (5) photoresist techniques; (6) apparatus-cleaning techniques and surface preparation; (7) diffusion techniques and control; (8) contact evaporation techniques; (9) mounting techniques; (10) bonding techniques; (11) sealing techniques; and (12) board-mounting and automatic-test equipment. I.v.L.

N64-18748 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AUTOMATIC ELECTRIC ARC WELDING OF TITANIUM
S. M. Gurevich and S. V. Mishchenko 12 Jul. 1963 23 p refs
Transl. into ENGLISH from Avtomat. Svarka, (Kiev), v. 9, no. 5 (50) 1956 p 1–12
(FTD-MT-63-31/1+2; AD-434945)

Questions of the technology of electric arc welding of titanium by a nonfused electrode in a steam of inert gas are considered. The peculiarities of the automatic welding of titanium under flux are outlined. Data concerning structure and mechanical properties of welded seams are given. Author

N64-18909 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Fourth Quarterly Progress Report, 1 Apr.–30 Jun. 1963
Earl Gomersall, Elmer Wolff, Milton K. Mack, and James H. Overman [1963] 28 p
(Contract DA-36-039-SC-86730)
(AD-433496)

2N656 device thermal resistance measurements indicate a power dissipation capability of 15 watts of 100° C case temperature. The planar device improvements include "hard" gold alloy wafer mounting, ultrasonically cold-bonded contacts, and an improved "slug" package. Varnishes and organics have been completely eliminated from the inside of the package. Purity of the encapsulated atmosphere is assured by a thorough cleaning and baking of all parts and by rigid control of the assembly and canning dry-box atmosphere. The aluminum wafer contacts are never exposed to etchants. Corrosive chemicals have been eliminated from the assembly process. Improved processes in the diffusion, photo resist, etch, evaporation, and plating areas have contributed to significantly increased product yields, quality, and uniformity. Process improvements have made possible the EIA reservation of a new device series, 2N2987 to 2N2994. Saturation properties and current-carrying capabilities have been sufficiently improved. Author

N64-18935 MSA Research Corp., Callery, Pa.
OPTIMUM PURIFICATION TECHNIQUES FOR THE REMOVAL OF CONTAMINANTS FROM LIQUID LITHIUM AND RUBIDIUM Final Report, Feb. 1963–Jan. 1964
S. J. Rodgers, F. Tepper, W. J. Carter, and C. A. Palladino Wright-Patterson AFB, Ohio AF Aero Propulsion Lab., Mar. 1964 83 p refs
(Contract AF 33(657)-10373)
(APL-TDR-64-34; AD-434544)

Techniques of analysis and purification of rubidium and lithium are described. A method for analysis of oxygen in rubidium based on freezing point depression was developed. The technique has a sensitivity of 10 ppm O_2 with a precision of ± 10 ppm O_2. Oxygen was removed from rubidium by stainless steel, zirconium, and 50% Zr-50%Ti alloy. The oxygen equilibrium value of rubidium in contact with stainless steel or zirconium is < 10 ppm at 1,400° F; with 50%Zr-50%Ti alloy the equilibrium value is < 10 ppm at 800° F. Hot trapping is recommended for purification of rubidium. Cold trapping was shown to be ineffective in removing oxygen. With 10 psi overpressure of nitrogen above rubidium, no evidence of rubidium nitride formation was observed. Rubidium hydride did not form when hydrogen was bubbled through rubidium. Author

N64-18946 General Dynamics/Fort Worth, Tex. Research and Engineering Depts.
ENGINEERING RESEARCH – SEALANTS – COMPOSITE FIBER-METAL O-RING – EVALUATION OF
M. T. Carroll and D. J. Pritchard 15 Apr. 1964 17 p
(Contract AF 33(657)-11214)
(ERR-FW-174; AD-436017)

This report describes the evaluation of a silver-impregnated composite fiber-metal O-ring seal fabricated for testing as a fuel seal in the temperature range of −100° to +1,200° F. The dimensions of the seal were 6 1/2-in. OD by 6 1/8-in. ID by 3/16-in. cross-section diameter. Based on the use of 16 equally spaced 3/8-in. diam bolts with centers on a 7 1/2-in. diam circle to supply the sealing force, a sealing pressure of 84,240 lb is equivalent to 180 in.-lb torque applied on the individual bolts. These data indicate that a satisfactory R.T. seal can be obtained with a composite O-ring under relatively low bolt torque values. Author

N64-18947 General Dynamics/Fort Worth, Tex. Research and Engineering Depts.
DENSIFICATION OF AN OXIDE POWDER MIXTURE
R. D. Potter 15 Jan. 1964 16 p refs
(Contract AF 33(657)-11214)
(ERR-FW-212; AD-436018)

Research was conducted to determine the effect of dynamic and static pressures upon materials. An oxide powder mixture containing iron, lithium, nickel, and zinc was studied as to densification techniques. Densification by impact was unsuccessful in a 150 ft/sec 500-gram device, but an increase in density was obtained by compacting and pressing to 100-kilobar pressure in a UniRam tetrahedral device. Author

N64-18948 General Dynamics/Fort Worth, Tex. Research and Engineering Depts.
ELECTROFORMING REFRACTORY METAL ALLOYS
E. W. Turns and J. F. Hildebrand 15 Apr. 1964 70 p refs
(Contract AF 33(657)-11214)
(ERR-FW-217; AD-436260)

Experiments to evaluate potential electroforming materials were conducted according to a three-phase program. First, 26 solutions capable of electrodepositing alloys were prepared, electroreduced, and the products examined. These solutions and products were examined for product uniformity, control of alloy ingredient, and solution stability. In the second phase three

solutions were selected from the screening test. Limited experiments were conducted with a nickel manganese alloy, whereas more extensive experiments were performed with a Co-W and a Co-W-Ni solution. In the third phase the latter two were adapted and improved to function as true electroforming solutions. Test specimens of a cobalt–nickel–tungsten alloy were prepared and tested to obtain tensile strength and hardness data. The tensile strength for this material was 46,000 psi, and the hardness was approximately Rockwell C 50. Author

N64-18977 Joint Publications Research Service, Washington, D.C.
GAS-FLAME BRAZING OF METALS
G. A. Asinovskaya 24 Apr. 1964 119 p refs Transl. into ENGLISH of the book "Gazoplamennaya payka metallov" Moscow, State Sci. and Tech. Publ. House for Machine-Building Lit., 1963 p 1–128
(JPRS-24345; OTS-64-31152) OTS: $2.50

Problems relative to gas-flame brazing with low- and high-melting point solders are elucidated, data necessary for the use of new equipment and apparatus are presented, the technological peculiarities of solders of various metals and alloys are explained, and data on safety techniques are offered. Author

N64-18979 Joint Publications Research Service, Washington, D.C.
BRAZING SAP-2 SINTERED ALUMINUM POWDER
V. L. Grishin 27 Apr. 1964 9 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 1, Jan. 1964 p 58–62
(JPRS-24355; OTS-64-31160) OTS: $0.50

The obtaining of braze joints of sintered aluminum powder (SAP) and the heat resistance of these joints were investigated. The following methods are discussed: (1) abrasive brazing; (2) resistance brazing; (3) dip brazing; and (4) furnace brazing. Mechanical and corrosion tests of the joints are also discussed. R.T.K.

N64-18981 Joint Publications Research Service, Washington, D.C.
SOME FEATURES IN THE ELECTROSLAG MELTING OF LARGE-DIAMETER CONSUMABLE ELECTRODES
Yu. V. Latash 28 Apr. 1964 12 p refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 6, 1958 p 76–83
(JPRS-24369; OTS-64-31165) OTS: $0.50

Results of the investigation of the melting of large-diameter electrodes during the electroslag process are presented. The association between the stability of the process and the form of the electrode tip is established. The influence of the depth of the slag bath on the nature of the electrode melting and on the depth of the metallic bath is shown. Author

N64-18990 Bureau of Mines, Reno, Nev.
DIRECT ELECTROLYSIS OF URANIUM DIOXIDE TO URANIUM METAL IN FLUORIDE MELTS
D. G. Kesterke, D. C. Fleck and T. A. Henrie 1964 16 p refs
(BMRI-6436)

Uranium metal was electrowon from uranium dioxide dissolved in fluoride melts. The uranium dioxide was fed directly to the cell in a continuous manner. Electrolysis was performed at 1,200° to 1,300° C in electrolytes composed of UF_4, LiF, and BaF_2. A single regulus of metal was collected in a confined area of the crucible. Product purity of 99.8% was attained. Carbon was the major contaminant. Compartmented cells were studied as a means of confining the oxide feed to the vicinity of the anodes. Author

N64-19008 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EVALUATION OF AUTOMATIC WIRE WRAP MACHINE
E. U. Baker 17 Dec. 1963 31 p refs
(SM-44664)

The results of an investigation of solderless wire-wrap connections produced by an automatic machine as compared with those produced by hand wire-wrapping tools are given. The investigation was conducted to determine whether the connections produced by the automatic machine were of equal or better quality and whether they would meet the requirements of DACo Process Requirements Drawing IP00032. Investigation determined superiority of automatic machine wrapped connections over those produced by hand wire-wrapping tools. The automatic machine produced more consistent results in both electrical and tensile values. Author

N64-19011 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
REWRAPPING OF WIRE WRAP TERMINALS
E. U. Baker 19 Mar. 1964 22 p refs
(SM-45946)

Investigation of solderless wire-wrap connections made on wire-wrap terminals subjected to wire removal and rewrapping is discussed. The investigation was conducted to determine whether the rewrapped connections were capable of meeting the physical and electrical requirements of DACO Process Requirements Drawing 1P00032. Wire removal and rewrapping operations do not adversely affect the operational or environmental capabilities of the connections. All test results met the requirements. Author

N64-19017 National Academy of Sciences. National Research Council, Washington, D.C. Materials Advisory Board
RECOMMENDED QUALITY STANDARDS FOR TUNGSTEN SHEET PRODUCED IN THE REFRACTORY METALS SHEET ROLLING PROGRAM
22 Jan. 1964 26 p
(MAB-196-M)

Tungsten sheet standards are presented as follows: scope, product limitations, identification, sampling, test procedure, visual inspection, dimensional tolerances, sonic inspection, chemistry, tensile properties, bend test, metallographic specimens, and hardness readings. R.T.K.

N64-19021 Nippon Oil Seal Ind. Co. Ltd., Tokyo (Japan)
A STUDY OF OIL SEALS FOR RECIPROCATING MOTION
H. Kambayashi and H. Ishiwata 1964 12 p refs Presented at the Brit. Hydromechanics Res. Asso. 2nd Intern. Conf. on Fluid Sealing, Cranfield, England, Apr. 1964
(Paper B-3)

The frictional characteristics of oil seals for reciprocating motion were investigated experimentally. The testing apparatus was newly made, and tests were performed with a variety of lip materials, shaft surface finishes, oil viscosities, pressures, and rubbing speeds. In these tests were found very different phenomena from those in the case of rotary shaft seals, previously illustrated theoretically and experimentally, because of the difference of frictional behavior. Author

N64-19023 British Hydromechanics Research Assn., Harlow
PRESSURE GENERATION IN RADIAL-FACE SEALS
B. A. Batch and E. H. Iny (Central Elec. Res. Labs.) 1964 15 p refs Presented at the 2d Intern. Conf. on Fluid Sealing, Cranfield, Eng., Apr. 1964
(*Its* Paper F 4)

Measurements of the thickness and pressure of the fluid film between the faces of a radial-face mechanical seal have revealed a twice shaft speed fluctuation in both thickness and pressure; the pressure increased as the gap decreased and vice versa, indicating that hydrodynamic lubrication conditions existed within the film. The peak-to-peak pressure fluctuations were found to be independent of supply pressure, speed and temperature at the "just sealing" point but increased with load, and were considerably influenced by speed beyond this point. It is believed that these fluctuations are produced by small vibrations of both faces, and it is concluded that flexibility of mounting and alignment of the faces can considerably influence sealing performance. Author

N64-19025 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

AUTOMATIC D.C. TIG WELDING SATURN S-IVB FITTINGS

J. Haryung and R. S. Wroth 11 Feb. 1964 18 p refs
(SM-44652)

In order to upgrade weld quality and to further automate Saturn S-IVB production, the automatic d.c. TIG process was implemented for fitting-to-dome welding. This program was established to generate d.c. TIG process data and to develop capability for production welding of fittings to domes. Weld tests were performed both in the laboratory and in the production shop. These tests demonstrated that the d.c. TIG process eliminated many of the difficulties associated with manual MIG welding of fittings to domes. Author

N64-19026 Los Alamos Scientific Lab., N. Mex.

LARGE SCALE ELECTROREFINING OF PLUTONIUM FROM PLUTONIUM-IRON ALLOYS

L. J. Mullins, J. A. Leary, and A. N. Morgan 7 Apr. 1964 35 p refs
(Contract W-7405-ENG-36)
(LA-3029) OTS: $0.75

Electrorefining processes have been developed for the recovery of plutonium from plutonium–iron alloys on the 3.5-kg scale. The process can be controlled to produce plutonium metal containing <35 ppm of iron and a total of <100 ppm of detectable metallic impurities. With an alloy initially containing 2.50 wt% iron, the recovery yield is ~82%. The theory of plutonium alloy electrorefining is discussed, and a method based on back e.m.f. measurements for controlling the process automatically is presented. Author

N64-19074 Union Carbide Nuclear Co., Paducah, Ky.

INVESTIGATIONS OF CARBON TO CARBON CONNECTED ANODE ASSEMBLIES IN FLUORINE GENERATORS

W. B. Goode, Jr., C. R. King, W. K. Henderson, and S. Bernstein 10 Apr. 1964 44 p refs
(Contract W-7405-ENG-26)
(KY-452) OTS: $1.00

This report describes an unsuccessful attempt to obtain further improvements in fluorine cell life by utilizing carbon-to-carbon anode connections. Two basic faults appear to have contributed to the rapid failure of cells tested. First, all of the carbon anode assemblies tested had inherent mechanical weaknesses. The most obvious fault was that the designs were found to depend too heavily upon the tensile strength of carbon, a material that has relatively poor tensile strength. A second major fault was evidenced by rapid deterioration of the carbon-to-carbon electrical connections, due to the exposure of these critical areas to direct fluorine contact. Author

N64-19112 Republic Aviation Corp., Farmingdale, N.Y. Mfg. Research

B-120VCA TITANIUM ALLOY EXTRUSION PROGRAM Interim Technical Engineering Report No. 2, 16 Nov. 1962-16 Feb. 1963

Murray H. Levine 16 Feb. 1963 48 p
(Contract AF 33(657)-8746)
(ASD-TR-8-103, Vol. 2; AD-299145)

The first series of the B120VCA titanium-alloy extrusion trials were successful in terms of the extrusion capability of the alloy at extrusion ratios as high as 80:1. Results of this trial indicate that the alloy is sensitive to attack by the billet protection glass currently being used for other titanium alloys. Push No. 9 using the A-418 glass formula avoided severe die wear experienced with the earlier push using the No. 85 glass. Author

N64-19153 Alpha Molykote Corp., Stamford, Conn.

PREVENTION OF CORROSION WHEN USING MOLYBDENUM DISULFIDE LUBRICANTS

[1964] 4 p refs
(Spec. Print 477)

Several factors were found that must be considered in the formulation of MoS_2-based, extreme-pressure greases and oils if the material is to have assured corrosion-preventive properties. First, the purity of the powder must be carefully controlled and then the factor of particle size must be evaluated. Finally, when required, the proper corrosion inhibitor or other additives must be selected and blended with the lubricant in the required proportions and compounded, not only so that the essential qualities of the lubricant are preserved but also so that the functional properties of the molybdenum disulfide are not impaired but, rather, are enhanced. Investigation of the merits of p-nonyl phenoxy acetic acid as a rust inhibitor was conducted. A low-concentration, fine-powder MoS_2 grease was selected as the subject of a corrosion test. One sample was blended with 1% of the inhibitor, and the other was used as a test control. The bearing lubricated with the inhibited grease showed no evidence of rusting, whereas the control bearing was partially corroded. It was, therefore, possible to nullify completely any rust-inducing tendencies of MoS_2 greases. R.T.K.

N64-19171 Bureau of Mines, Boulder City, Nev. Reno Metallurgy Research Center

TRANSFER OF SELECTED METALS IN TITANIUM ELECTROREFINING

E. K. Kleespies and T. A. Henrie 1964 13 p refs
(BM-RI-6437)

Electrolytic studies determined the transfer rates of the alloying constituents from molten titanium anodes to solid titanium cathodes in molten-salt systems. Nickel, tin, copper, bismuth, and manganese were selected on the basis of thermodynamic data and the melting point of the alloy system. The transfer of nickel, tin, and bismuth was very low. The content of these elements in the cathode was in the range of less than 0.01% to 0.001%. The copper transfer was 0.6 to 0.8 wt% in electrolytes containing titanium chlorides and 0.12 wt% in titanium fluoride salt systems. The manganese transferred at rates comparable to that of titanium. High-purity titanium and titanium–manganese alloys of uniform composition were produced by electrorefining molten titanium alloys in chloride electrolytes. Comparisons are made between the calculated and the actual quantities of metal transfer. Author

N64-19180 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PHYSICAL METALLURGY AND HEAT TREATMENT OF STEEL (SELECTED PARTS)
M. L. Bernshteyn and A. G. Rakhshtadt 2 May 1963 140 p refs Transl. into ENGLISH of chapters 4, 32, 35, 36 from the book "Metallovedeniye i Termicheskaya Obrabotka Stali" (Moscow), Metallurgizdat., 1961 p 49-58, 592-597, 670-709
(FTD-TT-62-1762/1-2; AD-408429)

Reviewed are the following: methods of determining residual stresses in cylindrical bodies, prismatic bodies (beams, plates), and in surface layers; the formation of austenite in the heating of steel; martensitic transformations; and the theory of tempering quenched steel. I.v.L.

N64-19187 Radio Corp. of America, Lancaster, Pa. Industrial Tube and Semi Conductor Div.
DIELECTRIC TO METAL SEAL TECHNOLOGY STUDY
A. C. Grimm and P. D. Strubhar Oct. 1963 245 p refs
(Contract AF 30(602)-2682)
(RADC-TDR-63-472; AD-432199)

The development of improved dielectric-to-metal sealing techniques, specifically for use with output windows for high-power microwave tubes, is discussed. Objectives of the program included the development of seals that would be vacuum tight when baked at 700° C, or a minimum of 450° C, and would remain vacuum tight after being cycled 1,000 times between 20° and 125° C. Improvements in the compression band sealing permitted the fabrication of windows that met the objectives of the program. The compression bands were made of high-strength alloys, and the windows were made of beryllium oxide and of Pyroceram 9606. Vacuum-tight refractory metal seals were made with molybdenum metalizing on both sapphire and beryllium oxide. These seals, which met the program objectives, were metalized with a mixture containing 90% fine-particle molybdenum and 10% fine-particle S-641A (a sealing additive). Fused silica seals and reactive metal seals did not meet the program objectives. An investigation of the dielectric losses in seals was made, and a method for assembling refractory metal seals, without voids or fillets in the seal area, was developed. This method is based on the vacuum casting of copper over the metalized sealing area. I.v.L.

N64-19198 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CERTAIN QUESTIONS RELATING TO THE THEORY OF THE WELDING OF PLASTICS BY ULTRASOUND
L. N. Skorokhodov 29 Apr. 1963 12 p refs Transl. into ENGLISH from Plasticheskie Massy (USSR), no. 11, 1962 p 33-35
(FTD-TT-63-359/1+2+4; AD-415653)

Some of the phenomena associated with ultrasonic plastic welding are analyzed. It was established experimentally that it is only possible to weld thermoplastics, since thermosets decompose when heated. Among the technological advantages of the ultrasonic method of welding is the generation of a maximum amount of heat in the welding zone without noticeable heating of the entire mass of the article being welded. A brief description is given of the process of welding plastics by ultrasound and of some of its applications in the manufacture of industrial articles. R.T.K.

N64-19200 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INFORMATION PERTAINING TO THE NEWS OF PROCESSING METALS ON A PRESS
P. Davidkov and St. N. Stamatov 4 Jun. 1963 7 p refs Transl. into ENGLISH from Tehnika (Belgrade), no. 10, 1961 p 36-37
(FTD-TT-63-568/1+2; AD-414761)

The following methods of machining metals under press are described: (1) deformation through vibration, (2) explosive stamping, (3) hydroelectric methods, and (4) electrical methods employing chipless stamping. R.T.K.

N64-19216 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEW METHOD OF IMPROVING THE MACHINABILITY OF CAST STEEL
S. V. Lominskiy 6 May 1963 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 6, no. 6, 1962 p 366-369
(FTD-TT-63-352/1+2+4; AD-405694)

Investigations showed that introducing sodium sulfur compounds into molten metal guarantees a significant improvement of cast-steel machinability from the point of view of cutting speed. A stick sulfur additive was found to improve cast steel less than a sodium sulfite additive. Repeated investigations showed that under both laboratory and industrial conditions, the cutting-speed level when machining steel casting with sulfur additives is sharply increased, i.e., the rate of cutter wear is decreased. It was determined that a high sulfur content in the casting decreases the cutting temperature and the abrasive capacity of the metal being machined. On the basis of these investigations, it was concluded that adding sodium sulfur compounds to cast steel immediately before pouring it into molds is an effective method of improving the machinability of steel castings. R.T.K.

N64-19224* General Electric Co., Cincinnati, Ohio Advanced Technology Lab.
LOW VISCOSITY BEARING STABILITY INVESTIGATION Final Report, 10 Oct. 1961-31 Dec. 1963
J. D. Mc Hugh 1 Apr. 1964 154 p refs
(NASA Contract NAS3-2111)
(NASA CR-54039) OTS: $11.50

The program described was conducted with the object of investigating rotor bearing stability. The bearings selected and tested included the following: the two-axial groove bearing of length-diameter ratio 1 and also 1 1/2; the three-lobe bearing; tilting pad bearing; the orthogonally displaced elliptical bearing; and the compound cylindrical bearing. Tests were conducted over a large span of variables, including: shaft speed, shaft clearance, static loads, unbalance, mass distribution, and lubricant. During the tests, the primary objective was to observe the effect of the bearing and rotor variables upon the stability of rotor motion; a second objective was the measurement of power loss for the bearings in turbulent operation. Accordingly, the test device was equipped with noncontacting displacement gages to measure shaft center position. Drive torque to the test rotor was measured with the aid of a special noncontacting instrumentation system sensing the twist in a long, thin drive shaft. Results of the test and recommendations based on these results are included. R.T.K.

N64-19226 Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.
OBSERVATIONS IN THE DEVELOPMENT OF TITANIUM-REFINING CELLS
Oliver Q. Leone 1964 31 p refs
(BM-RI-6432)

Three electrorefining cells were designed to investigate various factors associated with the electrorefining of reject-grade titanium sponge. Operation of the cells provided information on cell design as well as on how design and operating variables affected the quality of the titanium product. A sodium

chloride–titanium chloride electrolyte was used, and the electrolyte chambers had capacities ranging from 400 to 3,500 pounds of molten salt. Major factors investigated were electrolyte composition, temperature and useful life, effect of various cathode shapes and materials of construction, methods for removing cathode deposits, effect of current density and cell potential, and the mechanics of deposit growth and crystal morphology. Author

N64-19251 Merz-Chambers Corp., Indianapolis, Ind.
INSTRUCTION MANUAL FOR FLIGHT PROGRESS STRIP LOADER TYPE II
Nov. 1963 59 p

The complete operation and service instruction for the Flight Progress Strip Loader, Type II is presented. The Flight Progress Strip Loader is part of a data processing and display system, which will provide for partial automation of the air traffic control function. The specific requirement of this machine is to individually load printed flight progress strips (type FAA-561-X1) into nylon strip holders (type FAA-B-4497-E) and deliver the loaded holder to a delivery rack. The strips are manually carried from the printer and inserted into the machine strip-feed opening. After the machine performs the loading operation, the loaded holders are manually distributed for use on flight progress boards in the air route traffic control center for control of air traffic. Information is also included on loader safety features and wiring. R.T.K.

N64-19266 Naval Research Lab., Washington, D.C.
A NEW SEARCH TECHNIQUE FOR ULTRASONIC INSPECTION OF SHEET STEEL
S. D. Hart and L. C. Cardinal *In its* Rept. on NRL Progr. Mar. 1964 p 4–10 (See N64-19264 11-01) OTS: $1.25

The problem of detecting flaws in structural materials is both important and very difficult. Ultrasonics has appeared to be a promising technique, but attempts to measure all of the flaws in a specimen by means of a single transducer, or an array of transducers, are often unsuccessful. In spite of the engineering complications, an ultrasonic device with rotating transducers has now been designed and constructed, which is able to detect artificial flaws as small as 0.005 in. deep and 0.25 in. long made in steel plate. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-18532 Joint Publications Research Service, Washington, D.C.
INFLUENCE OF VACUUM MELTING ON PROPERTIES OF STEELS EI-846, EI-852, EI-847, AND EI-437B
V. M. Amonenko, I. S. Bolgov, M. P. Zeydlits, and V. M. Azhazha *In its* Vacuum Treatment of Metals 13 Apr. 1964 p 16–20 refs (See N64-18529 11-17) OTS: $1.00

Various types of steels prepared in an induction vacuum furnace and in an ordinary open-air furnace were compared with respect to mechanical properties (e.g., impact ductility, fracture, plasticity, ultimate strength, yield stress, etc.). In general it was found that melting steels under vacuum increases the plastic properties considerably and improves the other characteristics of the metals. Quantity and dimensions of nonmetallic inclusions are lowered, and the content of gases decreases significantly. P.V.E.

N64-18568 Indiana General Corp., Valparaiso
SUBMICRON PARTICLE MAGNETS OF IRON AND COBALT
H. M. Fulton Wright-Patterson AFB, Ohio. Aeron. Systems Div. Apr. 1963 47 p refs
(Contract AF 33(657)-8499)
(ASD-TDR-63-423; AD-420225)

Submicron particles of iron, cobalt, and iron–cobalt were made by electrodeposition into a mercury cathode. The gel of dendritic particles and mercury was pressed to form mercury-matrix magnets. Heat treatments of the gel to optimize particle shape were studied, together with the addition of small amounts of tin and similar metals that formed protective coatings on the particles and sometimes improved the magnetic properties. The magnets were distilled to remove as much mercury as possible, and the compacts were impregnated with resins or crushed, mixed with binders, and repressed. Lead-matrix and oxide-coated particle magnets were also made and studied. Mercury-matrix magnets were produced with energy products of 5.8×10^6 G Oe. Electron micrographs show that, in contrast to the fine structure of the submicron particles, a gross structure of the arranged particles may be important for determining the overall magnetic properties. Author

N64-18569 Indiana General Corp., Valparaiso Magnet Div.
SURFACE INVESTIGATIONS ON PERMANENT MAGNETS
K. J. Kronenberg and R. E. Quear Wright-Patterson AFB, Ohio. Aeron. Systems Div., May 1963 29 p refs
(Contract AF 33(657)-8499)
(ASD-TDR-63-424; AD-420234)

Several types of magnets of iron, cobalt, and iron–cobalt particles were made with different matrix materials. Magnets pressed from a gel of magnetic particles and mercury were used to evaluate the progress of the various phases of the process. These magnets are commonly referred to as mercury-matrix magnets. In order to eliminate the mercury, these magnets were distilled at high temperatures under a vacuum for several hours. This operation produced porous blocks of fine particles that were either vacuum impregnated with resins or crushed, mixed with binder, and repressed. Also, lead was added to the heat-treated gel before pressing. These magnets were distilled, crushed, and repressed and are referred to as lead-matrix magnets. Magnets have been made by superficially oxidizing submicron particles of iron–cobalt. The oxidized particles readily separate themselves from the mercury. Author

N64-18575 Indiana General Corp., Valparaiso Magnetic Research Lab.
MANGANESE-ALUMINUM FOR PERMANENT MAGNET MATERIAL Final Report
M. A. Bohlmann Wright-Patterson AFB, Ohio. Aeron. Sys. Div., May 1963 34 p refs
(Contract AF 33(657)-8499)
(ASD-TDR-63-422; AD-420236)

Manganese–aluminum alloys with 68% to 73% Mn were developed for permanent magnet material. Best magnetic properties were obtained in 71% Mn alloys. Maximum energy product was 4.0×10^6 gauss-oersted, reached by homogenization, controlled quenching, reducing the area 86% by swaging in jackets, and annealing. Process parameters were studied to find the optima for the brittle alloy. Deformation of the alloy produces a preferred magnetic axis and raises the coercive force. Swaging was best, but deforming by turning cast bars into chips on a lathe gave the best "particle" magnets and was

easiest. A review of the crystal and magnetic structures leads to the deduction that dislocation lines involve Mn atoms arranged antiferromagnetically and subdivide larger ferromagnetic regions. The magnetic saturation is not reached in a practical magnetizing field. The magnetic induction decreases with increasing temperatures to Curie point. Author

N64-18577 Westinghouse Electric Corp., Blairsville, Pa.
THE EXTRUSION, FORGING, ROLLING, AND EVALUATION OF REFRACTORY ALLOYS Technical Documentary Report, 1 Aug. 1962-31 May 1963
G. A. Reimann, D. R. Carnahan, and J. A. Visconti Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 108 p refs
(Contract AF 33(616)-8325)
(ASD-TDR-62-670, Pt. 2; AD-429115)

Wrought bars of tungsten-base alloys were produced by extrusion of arc-cast billets under a variety of conditions. Billets of W + 0.6Cb alloy were successfully extruded using temperatures between 3,200° and 4,200° F and reduction ratios between 3.9:1 and 8.3:1. The W + 6Mo + 2Cb alloy was extruded between 3,400 and 4,200° F by using ratios from 4.1:1 to 7.4:1. Surfaces were generally fair to poor, and internal cracks were discovered in many extrusions. Although swaging has been the most successful method for reduction of tungsten-base extrusions, higher tensile properties were obtained at 3,000° F on forged material (46,200 vs 63,300 psi for W + 0.6Cb). An ultimate strength of 48,200 psi was obtained on swaged W + 6Mo + 2Cb alloy. Author

N64-18578 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
AN APPARATUS FOR DIRECT AND DIFFERENTIAL THERMAL ANALYSIS AT TEMPERATURES UP TO 1500°C Final Report, Dec. 1959-Dec. 1962
Donald J. Evans and Karl Strnat Jul. 1963 33 p refs
(ASD-TDR-63-504; AD-418225)

An apparatus for direct and differential thermal analysis of small alloy samples has been developed and tested. The apparatus is suitable for phase diagram work up to 1500° C on binary alloys containing a rare metal as one constituent. It is almost automatic and yields a continuous record of the sample temperature and temperature difference versus time. The apparatus is described, and a few examples of heating and cooling curves obtained with the apparatus are shown. The accuracy of the measurements is discussed on the basis of calibration runs. Author

N64-18596 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
SOME OBSERVATIONS ON THE ELECTRON-MICROSCOPIC FRACTOGRAPHY OF EMBRITTLED STEELS
W. R. Warke 19 Feb. 1964 11 p refs
(DMIC-MEMO-187; AD-434987)

Both 500° F embrittlement and temper brittleness result in intergranular fracture along prior austenite grain boundaries. Since both of these embrittling reactions are grain-boundary phenomena, they must result from changes in the properties of the grain boundaries rather than from changes in the properties of the matrices. Both forms of embrittlement result in time-dependent elevation of the transition temperature, and both are promoted by the presence of certain minor elements in trace quantities. The use of electron-microscopic fractography in the study of these conditions has indicated that neither 500° F embrittlement nor temper brittleness can be attributed to precipitation of unique phases in the grain boundaries; no such phases have been observed or identified. There is some evidence, at least in the case of temper brittleness, that adsorbed layers of impurity atoms may be present on the grain boundaries. Author

N64-18622 Aerojet-General Corp., Azusa, Calif.
INVESTIGATION OF STRESS CORROSION CRACKING OF HIGH STRENGTH STEELS Informal Monthly Report, Feb. 1964
R. B. Setterland 27 Mar. 1964 6 p
(Contract DA-04-495-ORD-3069)
(LO414-02-6; AD-434247)

The current program status includes: (1) Four new heats of 18% nickel maraging steel, along with conventional alloys, are being tested in three environments to study the effects of compositional variation. These environments are: (a) aerated distilled water; (b) aerated 3% NaCl solution; and (c) water saturated air (140° F). Three replicate tests are being conducted for each test condition, using beam specimens stressed elastically to 75% of the yield strength, as well as plastically deformed U-bend specimens. The only maraging steel to resist cracking in the ambient distilled and salt-water environments was the 180-ksi-yield material, tested at 75% of yield strength. All maraging steel specimens failed in the 140° F water-saturated-air environment. (2) Environmental temperature was found to have a large effect on the failure time of maraging steel with the susceptibility doubling for every 18° F increase in temperature. Crack-growth-energy measurements on center-notch specimens are complete, except for two heat-treat conditions for the hot-worked die steel, and are listed. The stress-intensity factor, K, was found to have a large effect on the failure time of these specimens. Conversely, solution pH over a range of 3 to 11 was found to have little effect on failure time at constant K values. I.v.L.

N64-18670 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MECHANICAL PROPERTIES AND TEMPERATURE OF RECRYSTALLIZATION OF SINGLE CRYSTALS OF MOLYBDENUM
E. M. Savitskiy and Tao Tszu-tsun 15 Jul. 1963 10 p refs
Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk, Met. i Toplivo (Moscow), no. 4, 1962 p 133–136
(FTD-MT-63-43/1+2; AD-434969)

Purity of molybdenum after electron-beam zonal smelting reaches 99.9999% to 99.99999%—two or three orders higher than in industrial molybdenum. Purification occurs mainly due to degassing and evaporation of impurities in the course of melting in high vacuum. On stress-deformation curves of monocrystals of purified molybdenum, obtained in tests at room temperature, the site of fluidity is not observed that is characteristic of industrial polycrystalline molybdenum. Monocrystals of molybdenum after zonal smelting can be rolled into foil to more than 90% without appearance of visible cracks along the edges at room temperature and possess definite plasticity upon bending at −197° C in liquid nitrogen. Samples obtained from purified monocrystals of molybdenum with definite orientation after rolling to 90% have an initial temperature of recrystallization of 750° C versus 950° C in industrial molybdenum. Author

N64-18678 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BEHAVIOR OF TITANIUM ALLOYS DURING CORROSION UNDER STRESS IN ACID MEDIA
N. D. Tomashov and V. N. Modestova 27 Dec. 1963 17 p refs Transl. into ENGLISH from Titan i Ego Splavy, (Moscow) v. 6, 1961 p 221–229
(FTD-MT-63-123; AD-434997)

The long-time influence of dilute hydrochloric and sulphuric acids on alloy VT5 and titanium, and also of 60 0/0 sulphuric acid on alloy VT5, leads to the formation of a solid hydride layer of a greyish-blue color. Stress under these conditions of corrosion promotes penetration of hydrogen into the depths of alloy VT5 and titanium. On alloy VT5 the precipitation of hydrides of titanium emerges chiefly along the slip planes and partially in a direction perpendicular to that of applied external stress. The failure of samples of alloy VT5 is relatively brittle. During corrosion under stress of alloy VT5 an increase of speed of corrosion with an increase of concentration of acid, or an increase of stress with a constant concentration of acid, leads to a more ductile failure of samples with practically equal weight losses. During corrosion under stress in 10 0/0 hydrochloric acid, welded samples of titanium and especially of alloy VT5 were destroyed significantly faster than unwelded samples. Author

N64-18686 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INFLUENCE OF PURITY OF A METAL-BASE ON THE HEAT RESISTANCE OF AN ALLOY
A. A. Bochvar, Z. Z. Sviderskaya, and G. P. Lazarev 19 Dec. 1963 15 p refs Transl. into ENGLISH from Issled. Splavov Tsvetn. Metal., Akad. Nauk SSSR, Inst. Met. (Moscow), no.3, 1962 p 5–11
(FTD-MT-63-148; AD-434989)

A comparative study was made of the resistance to deformation of aluminum–copper alloys prepared with high-purity aluminum and with ordinary commercial aluminum as base. Prolonged indentation and time-prior-to-rupture tests were made. In order to investigate the structure and diffusion process of recrystallization of different grades of aluminum and of its alloys with copper, specimens were poured onto a polished steel slab, and their surfaces were examined with a microscope. Casting onto a cold slab made it possible to reveal dendritic structure of the alloys, but the recrystallization was not observed. Therefore, subsequent tests were conducted on a slab heated to 300° C, and the expected differences were detected. The results showed that alloys prepared with high-purity aluminum as base are significantly softer than alloys prepared with commercial aluminum. E.W.

N64-18702 Oxford U. (Gt. Brit.)
RESEARCH ON THE FREEZING AND MELTING POINTS OF IRON ALLOYS Technical Report
W. Hume-Rothery Nov. 1962 27 p refs
(Contract AF 61(514)-1062)
(ARL 63-11; AD-296222)

The liquidus, solidus, and A_4 transformation points have been determined for binary iron-rich alloys with C, Al, Ga, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Os, Ir, Pt, and Au. In the systems Fe-Al and Fe-Ga, liquidus and solidus curves have been determined for the whole range of composition, and some insight of the structures in the solid state has been gained. Liquidus and solidus relations in iron-rich Fe-Ni-C alloys have also been determined. In the binary systems, the liquidus, solidus, and A_4 transformation curves have been analyzed and used to determine the free energies, ΔG, of transfer of solute from solid→liquid and from $\gamma \rightarrow \delta$. Author

N64-18708 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A STUDY OF THE COMPARATIVE STRENGTH OF 354 TYPE ALUMINUM-SILICON-COPPER-MAGNESIUM CASTING ALLOY
W. A. Bailey 29 Jan. 1964 26 p refs
(SM-44636)

Previous work with 354-T61, an aluminum-silicon-copper-magnesium casting alloy, demonstrated a mechanical property advantage over the 356-variant T6 aluminum alloy currently used in production. This advantage was confirmed. Optimumly heat treated, 354-T6 aluminum alloy showed a 5% to 10% advantage in iron chill-cast ultimate and yield strength and a 20% to 35% advantage in part strength. The part strength levels achieved were comparable to the identical T-shaped configuration machined from wrought 1.5-in.-thick 7075-T6 aluminum alloy plate and considerably in excess of values obtained with 2014-T6. Author

N64-18709 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
CRYOGENIC PROPERTIES OF SEVEN EXPERIMENTAL TITANIUM ALLOYS
S. M. Weiman 17 Mar. 1964 29 p
(SM-44674)

This report provides room temperature, −196° C(−320° F), and −253° C(−423° F) smooth- and edge-notch tensile data for sheet specimens of seven experimental titanium alloys. Also provided are a few partial crack toughness data points for Ti-4Al alloy. The most promising alloys were Ti-5Al-2.5Sn with low iron content and Ti-4Al. Author

N64-18711 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
PRELIMINARY EXPLORATION OF THE ALUMINUM-SILICON-MAGNESIUM ALLOY SYSTEM, PART I
W. A. Bailey 31 Oct. 1963 24 p refs
(SM-43109)

This report outlines the evolution of cast 356-T6 type aluminum alloys. The early work suggested that a reduction of the iron contamination, or an increase in properly precipitated magnesium silicide should result in stronger, more ductile alloys. A preliminary series of aluminum alloys with constant magnesium and varying silicon and iron contents were cast into MIT chill plates, heat treated, and tensile tested. This exploratory test work partially confirmed the hypothesis that elongation might be improved with decrease in iron impurity. Author

N64-18712 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A-356 TYPE ALUMINUM CASTING ALLOY, PART I: EFFECT OF MAGNESIUM CONCENTRATION
W. A. Bailey 3 Dec. 1963 34 p refs
(SM-43094)

This investigation was conducted to determine the effect of variations on magnesium content on the mechanical properties and part strengths of high-purity 356-T6 type aluminum alloys. Both in sand castings and in chilled castings, at any aging temperature or time used experimentally, ultimate strength and yield strength increased directly with an increase in magnesium concentration from 0.33 to 0.74 wt %. Elongation varied inversely with the increase in magnesium content but was markedly retarded by maximal chilling. Part strength, as tested in bending, was increased by this increase in magnesium content approximately 8% when aluminum chills were used, 3% when iron chills were used, and little or not at all when unchilled. Author

N64-18713 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A-356 TYPE ALUMINUM CAST ALLOY, PART II: EFFECT OF BERYLLIUM CONCENTRATION

W. A. Bailey 20 Jan. 1964 43 p refs
(SM-44658)

This investigation was conducted to determine the effect of variations of beryllium content on the mechanical properties and part strengths of high-purity 356-T6 type aluminum alloys. Results are reported that were obtained from a series of similar T-shaped test castings, poured in both sand and permanent mold, using metal of six different compositions. The T's of all chemistries were solution heat treated similarly and were aged for various times at two temperatures. Both in sand castings and in chilled castings, at any aging temperature or time used experimentally, ultimate strength and yield strength increased from 5% to 10% with a 0.20 wt % increase in beryllium concentration. Elongation was not affected by beryllium additions. Part strength, as tested in bending, was increased by this increase in beryllium content approximately 5% when aluminum chills were used, 3% when iron chills were used, and 10% when unchilled. Author

N64-18714 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EVALUATION OF 18Ni-9Co-5Mo (300 KSI) MARAGING STEEL SHEET. PART I: MECHANICAL PROPERTIES
D. L. Corn 27 Nov. 1963 66 p refs
(SM-43110)

The mechanical properties, including fracture toughness, are presented to demonstrate its utility for high-strength pressure vessels. Uniaxial yield and ultimate strengths are reported for aging heat treatments ranging from 750° F for 312 hours (13 days) to 1,050° F for 18 hours. Mechanical properties are also presented for the annealed condition, as well as the effect of annealing temperature on aged strengths. The annealing study verified that austenite is stabilized in the 1,200° to 1,250° F annealing range. This austenite stabilization is accompanied by a drop in annealed yield strength of about 20 ksi, while the annealed ultimate strength is increased by approximately 20 ksi. It was also found that the material containing retained austenite does not respond to aging as well as the wholly martensitic structure does. Duplex aging cycles were also investigated and were shown to be capable of achieving higher strengths than could be obtained with a single aging heat treatment in the same amount of time. Author

N64-18715 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EVALUATION OF 18Ni-9Co-5Mo (300 KSI) MARAGING STEEL SHEET. PART II: METALLOGRAPHIC PROPERTIES AND METALLURGICAL CONSIDERATIONS
D. L. Corn 6 Feb. 1964 61 p refs
(SM-43111)

The grain size of the as-received material was observed to be less than ASTM 8. Annealing at 1,800° F for 6 hr increased this size to approximately ASTM 4. Annealing in the range 1,200° F to 1,250° F verified that austenite is formed and is retained in significant amounts upon cooling to room temperature. The mechanical properties of annealed material are also discussed. Material containing stabilized austenite displays annealed tensile properties that are a function of annealing temperature and time at annealing temperature. Typical microstructures of aged specimens are presented. Author

N64-18726* Battelle Memorial Inst., Columbus, Ohio
EXPLORATORY STUDIES OF MECHANICAL CYCLING FATIGUE BEHAVIOR OF MATERIALS FOR THE SUPERSONIC TRANSPORT
D. N. Gideon, C. W. Marshall, F. C. Holden, and W. S. Hyler Washington, NASA, Apr. 1964 63 p refs
(NASA Contract NASr-100(01))
(NASA CR-28) OTS: $1.75

The materials are AM-350 CRT steel and triplex-annealed Ti-8Al-1Mo-1V alloy. The three facets to the program are (1) base fatigue strength of the materials, (2) crack-propagation behavior, and (3) residual static strength. Crack-propagation studies were conducted on center-notched sheet specimens of AM-350 alloy to evaluate variables such as alternating stress amplitude, test temperature, cyclic rate, specimen orientation, and prior stressed exposure. As expected, alternating stress amplitude and test temperature appreciably affect crack-propagation rates, whereas, for times up to 1,000 hours, stressed exposure was not important. Residual-static-strength measurements also were made from center-cracked specimens of AM-350 alloy. Crack length and test temperature were found to be important variables, whereas stressed exposure and conditions under which the fatigue cracks were grown were found to be unimportant variables. Author

N64-18743 Martin Co., Denver, Colo.
CRYOGENIC MATERIALS DATA HANDBOOK Yearly Summary Report [Jun. 1962–Jun. 1963]
F. R. Schwartzberg, S. H. Osgood, and R. D. Keys Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1963 11 p
(Contract AF 33(657)-9161)
(AD-420406)

The background, organization, and maintenance of the *Cryogenic Materials Data Handbook* are discussed. An experimental program and its accomplishments in the past year are described. Handbook insert reports 12 and 13 were distributed in the past year. A new format for data presentation was introduced. Author

N64-18772 Horizons Inc., Cleveland, Ohio
REINFORCEMENT OF NICKEL CHROMIUM ALLOYS WITH SAPPHIRE WHISKERS Interim Report No. 1, 28 Oct. 1963–28 Jan. 1964
Robert H. Kelsey and Mark S. Vukasovich 17 Mar. 1964 54 p refs
(Contract NOw-64-0125-c)
(AD-435044)

Attempts to secure iron–alumina single-crystal fiber composites having high fiber loading and exhibiting high-strength reinforcement of the iron by inclusion of additives to the system prior to and during the fusion formation of the composite have not been successful. Additives have been presented as claddings on the fiber, as inclusions in the metal portion, and as special atmospheres during the melting of the metal phase. The inherent difficulties associated with high fiber loadings as opposed to low fiber loadings are described as being associated with both the chemical and physical aspects of composite formation. Author

N64-18800 Joint Publications Research Service, Washington, D.C.
KINETICS OF AUSTENITE GRAIN GROWTH IN ELECTROSLAG WELDING
G. V. Nazarov 21 Apr. 1964 11 p refs Transl. into ENGLISH from Svarochoye Proizvodstvo (Moscow), no. 12, Dec. 1963 p 10–12
(JPRS-24278; OTS-64-31115) OTS: $0.50

Thermal cycles for the case of electroslag welding of medium-alloy steels of 55 to 60-mm thickness on a copper cooling lining were plotted. Kinetics of grain growth in the

heat-affected zone under conditions of thermal cycling of electroslag welding were investigated. A higher degree of homogenization of austenite, in comparison with arc welding, is observed in line with grain growth, and the state of grain boundaries is also improved, as revealed by quenching. Comparison of impact strengths of samples heated by two thermal cycles showed that impact strength is increased upon decrease of holding time in the supercritical interval, i.e., in the presence of smaller grains. Selection of a more favorable thermal cycle is possible by changing the process and conditions of welding. Author

N64-18869 Naval Research Lab., Washington, D.C.
AN INVESTIGATION OF THE ROTATING-BEAM TEST FOR LOW-CYCLE FATIGUE CRACK PROPAGATION STUDIES
E. A. Lange, T. W. Crooker, and R. E. Morey 17 Mar. 1964 18 p refs
(NRL 6056; AD-435560)

A method is described for investigating the low-cycle fatigue behavior of high-strength, notch-tough materials, using standard rotating-beam fatigue machines. The method includes the application of tensile tests on partially fatigued specimens to obtain notch tensile-strength and crack depth information. An analysis based on experimental data from HY-80 steel specimens of three sizes and three heat treatments is presented. Crack depth and crack propagation rate are employed as parameters in the analysis. It is shown that the test can detect differences in low-cycle fatigue performance, resulting from specimen size and heat treatment. Variations in performance are found to correlate well with corresponding variations in the Charpy V energy values and the notch tensile strength to yield strength ratios for the materials tested. Author

N64-18893 Universal-Cyclops Steel Corp., Bridgeville, Pa. Refractomet Div.
DEVELOPMENT OF TUNGSTEN SHEET BY THE USE OF ULTRA-FINE TUNGSTEN METAL POWDER. PHASE I: TECHNICAL PROGRESS REPORT. Interim Report No. 1, 28 Jan. 1963-28 Mar. 1963
J. H. Schwertz Apr. 1963 87 p refs
(Contract AF 33(657)-10513)
(AMC-TR-8-107 (1); AD-404089)

The state-of-the-art analysis of using ultrafine tungsten metal powder consisting of 0.01 to 0.1 micron particles in the production of tungsten sheet products has been completed. Both the existing technology and industry capabilities as related to raw material availability, handling methods, consolidation practices, and conversion methods, have been analyzed. The three major commercial sources of ultrafine tungsten powder have performed limited experimentation in further consolidation of these powders. Government facilities and private research organizations have made limited investigation of the powder, consolidation, and fabrication characteristics. The state-of-the-art analysis included the recrystallization and ductile-to-brittle transition temperature behavior of sheet produced from conventional tungsten powders and their significance to this program. A program for Phase II of this contract is proposed. Author

N64-18925 Wright-Patterson AFB, Ohio Aeronautical Systems Div.
AN ANALYTICAL STUDY ON LIQUID CESIUM PURIFICATION IN VIEW OF CURRENT AND PROJECTED NEEDS
Richard H. Herald Sep. 1963 40 p refs Presented at ASD 1963 Sci. Eng. Symp. 18–19 Sep. 1963
(ASD-TDR-63-703; AD-427179)

Contaminants existing in liquid-alkali metal systems may exert deleterious effects on thermophysical properties, corrosivity, and handling characteristics. This paper presents an analytical study on the physicochemical and kinetic aspects of liquid-cesium purification, employing the hot-gettering technique. It reviews the properties and various aspects of handling sodium, potassium, rubidium, and cesium. In addition, typical sources of contamination are discussed. Author

N64-18930 Southwest Research Inst., San Antonio, Tex.
CONTAMINATION EFFECTS ON LIQUID RUBIDIUM AND LIQUID LITHIUM SYSTEMS [Final Report] 1 May 1962-15 Apr. 1963
W. D. Weatherford, Jr., Robert K. Johnston, M. L. Valtierra, and J. W. Rhoades Wright-Patterson AFB, Ohio, Aeron. Systems Div., Aug. 1963 150 p refs
(Contract AF 33(657)-8657)
(ASD-TDR-63-413; AD-408570)

A research program directed toward the goal of developing an improved understanding of contamination effects on liquid rubidium and liquid lithium systems is described. Experimental measurements were conducted on the vapor pressure of pure rubidium, and the melting point of pure and nitrogen-contaminated lithium. The results of this phase of the experimental program confirmed recently reported rubidium vapor pressure data, established that oxygen contaminant exists in rubidium as soluble rubidium monoxide, and revealed that lithium nitride precipitates from supersaturated lithium at relatively slow rates. Author

N64-18944 General Dynamics/Fort Worth, Tex. Engineering Dept.
CURRENT INFORMATION ON THE REFRACTORY METALS
C. E. King 15 Apr. 1964 67 p refs
(Contract AF 33(657)-11214)
(ERR-FW-049A; AD-436333)

Only a few alloys are added to those covered by the original report, but the elevated temperature data presented in the curves were completely revised to reflect the properties on production material obtained during 1961. Two refractory alloys were purchased in sheet form (0.040 in.), and the test results on one of these alloys are reported. This alloy is the 90% tantalum–10% tungsten. The other alloy is the 10% titanium–10% molybdenum–80% columbium alloy and was tested in 1962. Vendor data on the 90% tantalum–10% tungsten alloy in the 2,000° to 2,200° F region are considerably higher than the data obtained on this alloy demonstrating the wide scatter in properties obtainable on the same alloy chemistry. Author

N64-19009 Douglas Aircraft Co., Inc., Santa Monica, Calif.
REINFORCED STRUCTURAL COMPOSITES Interim Report
F. M. Smith 17 Feb. 1964 26 p refs
(SM-44666)

A technique of fabricating tungsten bodies of increased strength was sought. Vapor deposition of unstressed tungsten on stressed tungsten wires was selected as the method for attaining the objective of the program. Equipment was designed and constructed for the vapor deposition of tungsten metal from a gaseous mixture of tungsten hexafluoride and hydrogen onto a heated mandrel surface. A set of operating conditions was developed for the deposition of high-quality tungsten in the form of tubes of one inch outside diameter. While these tubes had good microstructures, taper existed in the wall thickness. Two tubes were fabricated that were reinforced longitudinally with stressed tungsten wires. Author

N64-19019 International Lead Zinc Research Organization, New York, N.Y.
ILZRO RESEARCH DIGEST NO. 13
Schrade F. Radtke 1 Apr. 1964 101 p refs

The following are discussed: (1) commercialization of research results—lead and zinc, (2) technical research on lead—architectural applications, wrought lead applications, cable sheathing, solders, joining, lead coated steel, battery applications, corrosion control, paints and pigments, lead chemicals, lead in ceramics, fundamental research, and health and safety. R.T.K.

N64-19024 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
WELDABILITY OF 18Ni-9Co-5Mo MARAGING STEEL SHEET
M. M. Mabry 16 Mar. 1964 72 p refs
(SM-44648)

The alloy is easily welded in either the annealed or the heat-treated condition. Sound TIG welds can be produced without benefit of preheat or postheat. Simple aging treatments resulted in ultimate strengths ranging from 240 ksi to 319 ksi. Cold-working or solution-annealing treatments of the weld deposit, followed by aging, improves the mechanical strength. Effects of titanium on weld strength were studied. Increasing the titanium content in the weld metal improves the weld strength. The hot-cracking tendency of the maraging alloy was compared to 4340 steel. The maraging steel is less susceptible to hot-cracking. The weldments are apparently resistant to cold or delayed cracking. The room temperature net-fracture strength was evaluated by the shallow-crack criterion. Author

N64-19030 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
QUARTERLY METALLURGICAL PROGRESS REPORT NUMBER 22, JANUARY 1 THROUGH MARCH 31, 1964
A. H. Roberson [1964] 27 p refs
(Contract AT(11-1)-599)
(USBM-U-1109) OTS: $0.75

Research is reported in the following areas: (1) rare-earth-alloy development, (2) hafnium-carbide property evaluation work, (3) thorium-alloy systems, (4) cold-mold induction melting, (5) investigation of the system uranium carbide–uranium nitride–uranium oxide, (6) thermodynamics of cold-mold arc melting, and (7) tungsten–rhenium tubing development. R.T.K.

N64-19037 Oak Ridge National Lab., Tenn.
MECHANICAL PROPERTIES OF SOME REFRACTORY METALS AND THEIR ALLOYS
H. E. Mc Coy, Jr., R. L. Stephenson, and J. R. Weir, Jr. Apr. 1964 43 p refs
(Contract W-7405-ENG-26)
(ORNL-3593) OTS: $1.00

A critical evaluation has been made of the available mechanical property data for Nb-, Mo-, Ta-, and W-base alloys. It was found that insufficient data are available to allow the design and construction of complex engineering systems involving these materials. A general evaluation of the potential service temperatures for Nb-, Mo-, Ta-, and W-base alloys was made on the basis that conventional alloys have been used up to two-thirds of their absolute melting point. Strengthening mechanisms that have been used to achieve high operating temperatures for conventional alloys and that could be applied to refractory alloys are discussed. A review of the literature on the effects of irradiation on the mechanical properties of niobium, molybdenum, tantalum, and tungsten has been made. The data, in general, show that the ductility of molybdenum, tantalum, and tungsten is reduced after irradiation at ambient temperatures. Author

N64-19040 European Atomic Energy Community, Brussels (Belgium)
STRUCTUAL CHANGES IN ALUMINA IN MOLTEN S.A.P. [EVOLUTION STRUCTURALE DE L'ALUMINE DANS LE S.A.P. FONDU]
G. Beghi, G. Piatti, and D. Quataert Joint Nucl. Res. Center Ispra Estab. (Italy), [Feb.] 1964 42 p refs Presented at the Conf. on Non-fissionable Metals and Nucl. Reactors, Bologna 16–18 Dec. 1963 In FRENCH; ENGLISH summary
(EUR-589.f) Available from the Belgium Bank and Trust Co., N.Y., Account No. 121.86: 60 Belg. Fr.

A study has been carried out on SAP (sintered aluminum powder) in the temperature range above the melting point of aluminum with a view to assessing the limits for the appearance of the typical dispersed-phase structure of the SAP itself and in order to gain some indications from the structural standpoint. Author

N64-19046 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
METALLURGY IN AEROSPACE TECHNOLOGY. BERYLLIUM
M. Herman [1963] 53 p refs

A review of the metallurgy of beryllium is presented. The properties of beryllium, the specific applications in terms of these properties, and the limitations in effectively exploiting these properties in the applications are discussed; the factors influencing the mechanical properties of beryllium are summarized. Extractive metallurgy and refining are reviewed. The various ways in which beryllium is fabricated into a usable item are discussed. Emphasis has been placed upon how the various forming operations influence the metallurgical structure, which in turn affects properties. A summary of the mechanical properties data is presented along with a discussion on how the properties are influenced by metallurgical considerations. The metallography, surface effects, toxicity, costs, and chemical analyses of beryllium are also presented. Author

N64-19051 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS Review of Recent Developments [Dec. 9, 1963-Mar. 9, 1964]
J. A. Houck 27 Mar. 1964 3 p refs
(AD-436397)

A brief review of new developments in the technology of molybdenum and its alloys is presented. The topics discussed are: (1) improved ductility by strain softening; (2) recrystallization kinetics of molybdenum sheet; (3) extrusion of molybdenum alloys; (4) TZM alloy forgings; (5) decarburization of Mo-base alloy; (6) tensile properties of Mo-Zr-C alloy; and (7) arc melting TZC alloy. R.T.K.

N64-19085 AeroChem Research Labs., Inc., Princeton, N.J.
KINETICS OF HIGH TEMPERATURE OXIDATION OF MOLYBDENUM BY DISSOCIATED OXYGEN
Daniel E. Rosner and H. D. Allendorf 19 Feb. 1964 5 p refs
(Contract AF 49(638)-1195)
(TP-84)

The mechanism of molybdenum oxidation by O_2 at $T > 1,000°K$ and $P_{O_2} > 10^{-2}$ *torr* was investigated under diffusion-free conditions, in an apparatus that consists of a pyrex Vycor-Pyrex vacuum flow system coupled to a 12.6 l/sec mechanical pump. It was found that the oxidation probability for O-atom attack of molybdenum can exceed that for O_2 by more than two orders of magnitude. The observed kinetic order and activation energy, considered together, suggest an alternate (Rideal type) mechanism involving oxidation by gas-phase

strikes on chemisorbed oxygen rather than a simple increase in the steady-state oxygen atom coverage. I.v.L.

N64-19114 General Electric Co., Schenectady, N.Y. Research Lab.
EFFECT OF BASIC PHYSICAL PARAMETERS ON ENGINEERING PROPERTIES OF INTERMETALLICS Technical Report, Dec. 1962-Dec. 1963
J. H. Westbrook, H. E. Grenoble, and D. L. Wood Wright-Patterson AFB, Ohio AF Mater. Lab., Mar. 1964 33 p refs
(Contract AF 33(616)-7714)
(WADD-TR-60-184, Pt. [illegible] AD-433254)

Ingots of nickel-rich NiAl were prepared by induction melting under argon, starting with primary materials of technical grade. Sections cut from these ingots have been hot rolled to sheet at 1,100° to 1,200° C by enclosing them in heavy-walled stainless steel containers. Rolled sheet sufficiently free of defects to enable preparation of mechanical test specimens is obtained. Cold-rolling of the hot-rolled sheet can be accomplished at 850° C but requires a heavy reduction (about 30%) in each pass to avoid fracture. Hot-rolled NiAl undergoes a transition to brittle behavior at about 600° C. Below this temperature the mechanical properties are characterized by limited ductility, a sensitivity to surface notches, and by a flow stress that is relatively invariant in respect to temperature. Above 600° C, ductility increases markedly, sensitivity to surface conditions diminishes, and the flow stress becomes strongly temperature dependent. Single crystals do not exhibit a transition in mechanical behavior and are much weaker and more ductile than polycrystalline material at temperatures below 800° C. Author

N64-19138 Aerojet-General Corp., Azusa, Calif.
INVESTIGATION OF STRESS-CORROSION CRACKING OF HIGH STRENGTH STEELS Informal Monthly Report, Jan. 1964
W. L. Bruckart Mar. 1964 15 p
(Contract DA-04-495-ORD-3069)
(L0414-02-5; AD-432476)

Activities are reported on: (1) the study of the stress–corrosion characteristics of 18%-nickel maraging steel with respect to compositional variation; (2) the study of the effect of environmental temperature on the rate of stress–corrosion cracking in 18% nickel maraging steel, a low-alloy martensitic steel, and a hot-worked die steel; and (3) a study of the electropotential changes occurring in 18%-nickel maraging steel during stress–corrosion exposure, and the effect of applied potential. R.T.K.

N64-19158 New England Materials Lab., Inc., Medford, Mass. Research Div.
DISPERSION STRENGTHENED NICKEL-BASE ALLOYS Final Report, 1 Mar.-31 Dec. 1963
A. S. Bufferd, R. C. Nelson, and N. J. Grant 24 Feb. 1964 24 p refs
(Contract N600(19)-59891)
(AD-432420)

The dispersion strengthening of 80 nickel–20 chromium and Udimet 500 modified compositions was investigated with thorium oxide introduced by mechanical-mixing or thermal-decomposition techniques. Thermal decomposition of thorium nitrate onto 80 nickel–20 chromium powder produced a better degree of thorium oxide dispersion than mechanical mixing. The 100-hour rupture-life stress of 80 nickel–20 chromium at 1,800° F was increased from 1,600 to 3,400 psi with the addition of 5 volume percent thorium oxide. In addition, the effect of further cold deformation after extrusion on properties was investigated with 2.5 and 5 volume percent thorium oxide dispersions in 80 nickel–20 chromium. Author

N64-19159 General Dynamics/Fort Worth, Tex.
INTERMITTENT CREEP AND STABILITY Fourth Quarterly Progress Report, 15 Apr.-15 Jul. 1963
26 Jul. 1963 29 p
(Contract AF 33(657)-8907; Contract AF 33(657)-11687)
(FPR-007(4); AD-436759)

The PH 15-7 Mo stainless-steel specimens have been changed to PH 14-8 Mo stainless steel specimens. Materials are being tested for fracture toughness and mechanical properties instead of being only heat soaked. The time span has been extended to 30,000 hours of creep loading and heat soaking of the specimens prior to testing. Creep measurements are made during this time, and the influence of intermittent and steady creep on fracture toughness and on mechanical properties, as a function of creep strain and heat exposure, is determined. G.D.B.

N64-19163 Battelle Memorial Inst., Columbus, Ohio Defense Information Center
POWDER METALLURGY Review of Recent Developments
V. D. Barth 17 Apr. 1964 2 p refs
(AD-437378)

Developments in powder metallurgy include the following: Low-melting metal spheres having precalculated diameters of the order of 1 mm were made by drop formation under carefully controlled conditions. A patent for the slip casting of molybdenum and tungsten powders and one for sintering tungsten powder were issued. A comprehensive study of the consolidation and properties of high-purity samples of TiB_2, ZrB_2, HfB_2, and TaB_2 has been completed. In this study, polycrystalline bodies were prepared by high-pressure hot pressing. Properties measured on the consolidated bodies included lattice parameter, X-ray thermal expansion, linear thermal expansion, electrical resistivity, microhardness, thermal conductivity, specific heat, vapor pressure, and heat of formation. Direct visual evidence of the presence of plastic flow in the sintering of glass and cellulose acetate has been obtained. A new procedure for making dispersion-strengthened SAP-type aluminum products by a mechanical-blending procedure is reported. A powder-metallurgy composite of Cr and 2 wt. % MgO was made, which had an average room-temperature elongation of 50%. Research is underway to produce foamed metal structures for space capsules by a powder-metallurgy approach. Nonpyrophoric submicron carbides that have been produced are TiC, VC, NbC, TaC, and W_2C. I.v.L.

N64-19222* General Electric Co., Cincinnati, Ohio Missile and Space Div.
POTASSIUM CORROSION TEST LOOP DEVELOPMENT Quarterly Progress Report 2, Oct. 15, 1963-Jan. 15, 1964
E. E. Hoffman, ed. [1964] 24 p refs
(NASA Contract NAS3-2547)
(NASA CR-54008) OTS: $2.60 ph

The object of this program is to develop a prototype corrosion test loop for the evaluation of refractory alloys in boiling and condensing potassium environments that simulate projected space electric-power systems. The envisioned prototype test consists of two-loop Cb-1Zr facility; sodium will be heated by direct resistance in a primary loop and will be used in a heat exchanger to boil potassium in the secondary, corrosion test loop. Program status is reported in the following areas: loop design, material and equipment procurement, component evaluation Test loop I, loop II fabrication, helium purification system, and helium analysis system. R.T.K.

N64-19233 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Mulheim an der Ruhr (W. Germany) Inst. für Werkstoffforschung

INVESTIGATIONS FOR INCREASING FATIGUE RESISTANCE OF ALUMINUM ALLOY RIVETED JOINTS SUCHUNGEN ZUR VERBESSERUNG DER DAUERFESTIG- [UNTERSUCHUNGEN ZUR VERBESSERUNG DER DAUERFESTIGKEIT VON NIETVERBINDUNGEN AUS ALUMINIUMLEGIERUNGEN]

F. C. Althof [1963] 26p refs In GERMAN Presented at the Wiss. Ges. fur Luft- u. Raumfahrt Ann. Meeting, Munich, 8–12 Oct. 1963

(Res. Rept. 11; WGLR-Paper-34)

Investigations for increasing the fatigue strength of aluminum alloy riveted joints were conducted. Emphasis was placed on the effect of different compositions of semifinished joints on their physical properties. The compositions investigated were; various Al-Cu-Mg alloys, various Al-Zn-Mg-Cu alloys, and various St-42 steels. Measurements were of fatigue strength and tensile strength of bars of the alloys and of the fatigue strength of their joints. Also, the relationship between strain, shearing stress, and pressure exerted by a rivet on the inside of the rivet hole is given for joints consisting of two sections and one rivet and of two sections and three rivets. Results indicate that impurities in the raw materials lower the fatigue strength. An improvement in the purity of these materials will lead to an improvement in fatigue strength of riveted joints. I.v.L.

N64-19238 Joint Publications Research Service, Washington, D.C.

THE EFFECT OF THE CARBON CONTENT ON THE DIFFUSION OF HYDROGEN IN CARBON STEELS

G. I. Batalin and A. L. Balyasnyy 29 Apr. 1964 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaved. Chern. Met. (Moscow), no. 3, 1961 p 120–125

(JPRS-24383; OTS-64-31172) OTS: $0.50

The effect of carbon content on the diffusion of hydrogen in carbon steels melted under plant conditions was investigated. The penetration of hydrogen through single membranes made of 20, 30, 40, U8, and 20Kh steels was studied. A vacuum apparatus was designed for this purpose. The coefficient of permeability of hydrogen into steel was calculated from the experimental data obtained, and was compared with the data of Bennek and Klotzback. R.T.K.

N64-19239 Bureau of Mines, Rolla, Mo.

EFFECTS OF SUBSTITUTING COBALT FOR NICKEL ON THE TENSILE PROPERTIES AND HARDNESS OF TWO TYPES OF STAINLESS STEEL

M. M. Tilman 1964 20 p refs

(BM-RI-6427)

The purpose of this investigation was to determine the effects of small amounts of cobalt in nickel on the tensile properties and hardness of representative types of austenitic stainless steels. Cobalt substitutions for nickel up to 2 wt.% were made in types 302 and 309 stainless steels. Data were obtained at room temperature for tensile strength, yield strength, percentage elongation, percentage reduction in area, and hardness. Author

N64-19249 Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.

INVESTIGATIONS OF SOME EXPERIMENTAL FUEL ELEMENT ALLOYS WITH THE ELECTRON MICROPROBE

L. A. Fergason, D. L. Parker, and N. F. Neumann 15 Apr. 1964 21 p refs

(Contract W-14-108-ENG-8)

(MCW-1483) OTS: $0.50

The microstructures of seven alloys were investigated with the Cambridge microprobe. Six of the alloys were uranium containing the following combinations of other elements: S; P; Zr, Fe, and Al; Zr and P; Fe and Si; and Al, Fe, and Si. One was a section of a thorium fuel element. Author

N64-19277 Joint Publications Research Service, Washington, D.C.

TITANIUM EQUIPMENT IN THE PRODUCTION OF NICKEL

G. M. Itel'son and V. B. Zhilkin 21 Apr. 1964 105 p refs Transl. into ENGLISH of the book "Titanovoye Oborudovaniye v Proizvodstve Nikelya" Murmansk Publ. House, 1963 p 1–126

A number of titanium alloys were tested for corrosion stability, and were found to be suitable for use in the production of nickel. Properties and applications of titanium, design of welded titanium pumps and shutoff devices, titanium cathodes, and machining, forging, stamping, and welding of titanium are discussed. E.W.

N64-19286 Atomics International, Canoga Park, Calif.

STUDY OF METALLURGICAL DEFECTS IN APM PRODUCTS

P. B. Ferry and W. H. Friske 15 Apr. 1964 33p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-8262) OTS: $0.75

Metallurgical defects found in aluminum powder metallurgy (APM) extrusion billets and fabricated shapes are discussed. The defects observed included macrosegregation, microsegregation, inclusions, and voids. Macrosegregation was observed as darkly etched bands in billet stock, extruded rods, and finned tubing. Microsegregation, visible by optical microscopy at high magnifications, was observed as stratified layers of the dispersed phase. Inclusions found in extrusion billets are believed to be iron-rich particles, originating in the powder process. The larger inclusions were broken up into stringers during subsequent fabrication. Voids were present in billet sections, and have been observed in extruded tubing. Nondestructive testing techniques for detecting these defects were investigated. Ultrasonic tests were successful in detecting macrosegregation in billets and voids in sheet stock. Eddy current tests located small inclusions and voids in tubing. An electron-microprobe X-ray analyzer was used to investigate the composition of inclusions and segregated zones. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-18562 Princeton U., N.J. Frick Chemical Lab.

EFFECT OF PLASTICIZER, CHAIN ENDS AND COMONOMER ON THE GLASS TRANSITION TEMPERATURE OF POLYMERS

M. C. Shen and A. V. Tobolsky Apr. 1964 17 p refs

(Contract Nonr-1858(07))

(ONR-TR-RLT-75; AD-434299)

The effect of low concentrations of plasticizer, chain ends, or comonomer, on the glass transition temperature of a polymer can be described by a linear equation with respect to the weight fraction. Over the entire range of composition, these

effects can be approximately described by a quadratic equation. The interrelation of all of these equations is discussed and considered. Author

N64-18605 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
DILUTE SOLUTION PROPERTIES OF HIGH-MOLECULAR-WEIGHT POLY(ISOBUTYL METHACRYLATE). I. VISCOSITY IN METHYL ETHYL KETONE
Richard J. Valles, Eleanor C. Schramm, James Stout, and David W. Levi Feb. 1964 36 p refs
(PA-TR-3113; AD-434893)

The viscosities of methyl ethyl ketone solutions of high-molecular-weight poly(isobutyl methacrylate) were found to be shear dependent. Corrections for this shear dependence were applied by using a five-bulb capillary viscometer. The data were treated by a conventional double plot method, a triple plot method, and by including a higher concentration term. Intrinsic viscosities obtained from the different treatments agreed well. Author

N64-18710 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ADHESIVES AND RESINS FOR MISSILE APPLICATION
L. M. Roseland 25 Feb. 1963 26 p refs
(SM-44660)

This study presents the mechanical strengths of new heat-resistant polymeric materials. These include polyimide and polybenzimidazole resins. Results include overlap shear strengths, laminate tensile strengths, and laminate flexural strengths. Author

N64-18765 IIT Research Inst., Chicago, Ill. Technology Center
GLASS FIBER STRENGTH ENHANCEMENT THROUGH BUNDLE DRAWING OPERATIONS Fourth Quarterly Progress Report, 7 Mar.-7 Jun. 1963
R. H. Cornish and R. M. Chaney 1963 26 p
(Contract N600(19)58450)
(IITRI 8263-4; M-263; AD-416134)

Work toward the development of a production technique for bundle drawing fibers with greatly enhanced tensile strength is described. This work includes studies on size, dependence of strength, wetting–dewetting of glass fibers by metals, metallizing techniques, bundle drawing studies, bundle separation studies, and specimen fabrication. Fibers in the size range from 1μ to 3μ have been drawn in bundles, separated from the bundles, and shown to exhibit tensile strength well in excess of 1,000,000 psi. Superstrength fibers produced by this method can be made in continuous lengths as opposed to "whiskers," which are limited to discrete lengths. Author

N64-18770 Rock Island Arsenal Lab., Ill.
HIGH TEMPERATURE, NON-REFLECTIVE EROSION RESISTANT ALUMINUM FINISH
J. Knanishu 26 Nov. 1963 14 p refs
(Rept. 63-3894; AD-432321) OTS: $0.50

A number of soluble inorganic compounds were used in reactions to deposit insoluble colored precipitates (pigments) in the pores of anodized aluminum alloys. Many colors and shades were obtained by using the variables of time of immersion, temperature, and concentrations of the coloring solutions. The effects of the alloying constituents were observable in the colors obtained. There is a notable scarcity of inorganic compounds that can be used to produce a black or olive drab color on anodized aluminum. Alundum blasting improves variability and depth of colors. By proper control of the hard anodize process, excellent shades of light-fast, nonreflective olive drab colors can be produced. Author

N64-18790 Mc Gill U., Montreal (Canada) MacDonald Physics Lab.
THE ELECTRICAL PROPERTIES OF SALINE ICE Final Report
J. R. Addison and E. R. Pounder 30 Jan. 1964 25 p refs
(Contract AF 19(604)-8378)
(AFCRL-64-52; AD-434346)

A review is given of the literature on the electrical properties of saline ice. Because sea ice is quite inhomogeneous, with relatively large crystal sizes and with a strongly preferred horizontal inclination of the *c*-axis, measurements should be made on a sample that is large compared to the crystal size and should be made along two mutually perpendicular directions. Results are given for a number of samples of varying salinity over the frequency range from 20 cps to 100 mc. All measurements were made at −22° C. Extraordinarily large capacitances are found at audiofrequencies. If these are considered to result from the bulk dielectric coefficient of the ice, dielectric coefficients are obtained that range from about 10^6 at 20 cps down to less than 10 at 100 mc. The coefficient varies approximately as the reciprocal of the frequency in the audio range, and decreases more slowly with higher frequencies in the RF range. Author

N64-18823 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
A REVIEW OF DATA ON HEAVY METAL REFRACTORY COMPOUNDS
H. L. Schick *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 187–212 refs (See N64-18801 11-13)
(Sponsored by AF-ASD)

A limited review of the general properties of refractories is presented. Particular refractories discussed are titanium, zirconium, hafnium, niobium, tantalum, and vanadium. P.V.E.

N64-18882 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XII: DEVELOPMENT OF AN IMPROVED LARGE DIAMETER FINE GRAIN GRAPHITE FOR AEROSPACE APPLICATIONS Technical Report, May 1960-Aug. 1962
C. W. Waters and E. L. Piper Wright-Patterson AFB, Ohio. AF Mater. Lab., Mar. 1964 39 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 12; AD-435814)

This report describes a method for producing graphite using a pressure curing process. The process is based on a thermosetting binder system and is employed to develop a reasonably uniform fine-grain graphite. Also presented are the investigations of the process variables associated with attempting to reach optimum properties and with scaling up to 30-in.-diam sizes. This graphite, designated grade RVA, is nominally characterized by a bulk density of 1.85 g/cc (room temperature), with and against grain flexural strengths of 3,700 and 2,900 lbs/in^2, respectively, with and against grain elastic moduli of 1.7 and 1.3 million lbs/in^2, respectively, and variations in these properties of only 1/2 to 1/3 of those normally associated with quality industrial graphites such as grade ATJ. Author

N64-18894 Borden Chemical Co., Philadelphia, Pa. Central Research Lab.
STUDY LEADING TO THE DEVELOPMENT OF REINFORCED HIGH TEMPERATURE ELASTOMERS Final Report, Sep. 1962-Sep. 1963
K. C. Tsou, S. J. Makower, R. N. Goldey, and B. D. Halpern [1964] 30 p refs
(Contract DA-36-034-AMC-3791-W)
(AD-432322)

Filler–rubber systems containing various chemical modifications of silica and fibrous talc as fillers have been evaluated at 500° F after aging at 500° F. Trimethylsilyl (TMS) silicas are more suitable than triphenyl silicas. Fibrous grades of talc were superior as nonreinforcing fillers. Best improvement was obtained with a combination of TMS silica and fibrous talc modified by chlorosilanes. Additional incorporation of vinyl chlorosilane improved high-temperature elongation. Author

N64-18902 General Technologies Corp., Alexandria, Va. Materials Div.
A STUDY OF HIGH MODULUS, HIGH STRENGTH FILAMENT MATERIALS BY DEPOSITION TECHNIQUES Second Bi-Monthly Progress Report, 1 Jan.-29 Feb. 1964
L. G. Davies and J. C. Withers 15 Mar. 1964 14 p
(Contract NOw-64-0176-c)
(AD-433501)

Silicon carbide and titanium carbide filaments were deposited by vapor deposition techniques. An abbreviated study of the effect of varying deposition parameters upon tensile strength was made using boron filaments produced from diborane. The tensile strength was found to vary widely by adjusting the deposition parameters of temperature and gas ratios. The tensile strength of all materials deposited to date was measured. Author

N64-18922 General Dynamics/Fort Worth, Tex. Engineering Dept.
RESEARCH ON PHENYL SILANE HIGH TEMPERATURE LAMINATING RESINS
J. W. Head 15 Apr. 1964 21 p
(Contract AF 33(657)-11214)
(ERR-FW-126; AD-436267)

Several manufacturers reported that laminates made from phenylsilane resin showed good properties to temperatures of 700° F. These manufacturers also reported that the material was difficult to laminate and was very sensitive to time–temperature–pressure cycles. Limited quantities of phenylsilane preimpregnated materials were obtained from five manufacturers for use in this program. The reported handling difficulties were confirmed. A satisfactory layup procedure was developed using a bonding blanket technique after lengthy experiments. No testing of specimens for structural properties was conducted during this research period. Author

N64-18986 California U., Berkeley. Lawrence Radiation Lab.
FIRST-STAGE DENSIFICATION OF CaF_2 UNDER PRESSURE AND TEMPERATURE
Yasou Hashimoto (M.S. Thesis) 21 Jan. 1964 40 p refs
(Contract W-7405-ENG-48)
(UCRL-11214) OTS: $0.75

The initial densification of spherical CaF_2 powders was determined by dilatometric and microscopic observations. The experiments consisted of heating the powder to a fixed temperature at a constant rate under a load and then releasing the load and quenching. Further experiments were performed by heating the powder to a fixed temperature without load application, rapidly applying the load and holding for 40 sec or 1 hr, and releasing the load and quenching. The initial stages of hot pressing were divided into three regions. Region I exhibited little densification. Region II showed densification by limited plastic flow and fracturing. Region III above a pressure-dependent critical temperature, exhibited extensive densification due to plastic flow, fracturing of particles, and their subsequent rearrangement. Author

N64-18989 Bureau of Mines, Tuscaloosa, Ala.
THERMODYNAMIC PROPERTIES OF SODIUM BROMIDE AND SODIUM IODIDE AT LOW TEMPERATURES
T. Estelle Gardner and A. R. Taylor, Jr. 1964 12 p refs Work done in cooperation with Ala. U.
(BMRI-6435)

Heat capacity measurements were made on sodium bromide and sodium iodide in the temperature ranges of 7° to 300° K, and 56° to 300° K, using an adiabatic calorimeter. Smooth values of heat capacity, entropy, enthalpy function, and free-energy function were calculated from the heat capacity data at 10° K intervals and at 273.15° and 298.15° K. Entropy and free energy of formation values at 298.15° K also were calculated for the two compounds using entropy values determined in this study and other data reported in the literature. The entropy values calculated at 298.15° K were 20.75 ±0.06 entropy units (eu) for sodium bromide and 23.55 ±0.07 eu for sodium iodide. Author

N64-19007 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EXPANDABLE SPACE STRUCTURE MATERIAL RESEARCH
M. Moss and L. M. Roseland 14 Jan. 1964 35 p refs
(SM-44641)

The experimental stress-strain behavior of two organic fibers—HT-1, an aromatic polyamide, and Dacron, a polyester—and various yarns composed of these fibers, is presented. The tensile properties of each fiber in a particular yarn and fabric form are compared. Author

N64-19010 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
BONDING REACTION AND MECHANISM IN CHEMICALLY BONDED ZIRCONIA Interim Report
V. H. Edlin 23 Mar. 1964 40 p refs
(SM-45945)

The initial phase of research to understand the bond mechanism involved in chemically bonded zirconia is discussed. Chemical-bond phenomena were investigated by thermal gravimetric analysis, differential thermal techniques, X-ray diffraction, and stoichiometry studies. Zirconium pyrophosphate (ZrP_2O_7), and hydrated zirconium tetrafluoride ($ZrF_4 \cdot XH_2O$), were identified as reaction products for zirconia, chemically bonded by monofluorophosphoric acid. Author

N64-19022 Dowty Seals Ltd. (Gt. Brit.)
HIGH TEMPERATURE ELASTOMERIC AND METALLIC SEALS FOR AIRCRAFT HYDRAULIC SYSTEMS
B. C. Smithers 1964 30 p refs Presented at the Brit. Hydromechanics Res. Assn. 2nd Intern. Conf. on Fluid Sealing, Cranfield (Gt. Brit.), Apr. 1964
(Paper C-3)

Design and evaluation of elastomeric seals for the increased operating-temperature requirements of current aircraft hydraulic systems are discussed. The limitations of existing materials in such high-temperature hydraulic fluids as Silicodyne H, RD.6195 (silicate esters), Oronite M2, and Castrol H.130/63 are expanded. Some of the problems of introducing metallic-type seal configurations are also explained. Author

N64-19049 Aerojet-General Corp., Sacramento, Calif.
DEVELOPMENT OF HIGH-STRENGTH IMPREGNATED ROVING FOR FILAMENT WINDING Bimonthly Report No. 4, 11 Oct. to 10 Dec. 1963
20 Feb. 1964 16 p
(Contract NOw-63-0627-c FBM)
(Rept. 0627-V-4; AD-435034)

Progress is described in a program conducted to improve uniformity and strength utilization in preimpregnated roving for filament-wound rocket chambers. Various test methods were examined to determine those most suitable for use in this program. Strength data were obtained both for strands and for weak hoop chambers made with low end-count rovings. Preliminary data were obtained that indicate the effect of twist upon filament strength. A sample of eight rolls of single-end 0-twist glass roving was used for conducting a trial run of a test device developed to produce linearized-end preimpregnated roving. The initial dry run was unsuccessful because of excessive abrasion and fraying of the glass roving when it came in contact with the upright guides of the fixed comblike condensers. An alternative approach of using concave rollers in place of the comblike condensers was found to be more satisfactory in achieving the desired alignment of the roving. R.T.K.

N64-19129 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
HOLLOW GLASS FIBER REINFORCED PLASTICS
B. Walter Rosen and A. E. Ketler, Jr. May 1963 166 p refs
(Contract NOw-61-0613-d)
(R63SD41; AD-403827)

A program to evaluate the improvement in bulk properties obtained by using hollow glass fibers as the reinforcing material for glass–plastic composites was conducted. Controlled fabrication of fibers and uniaxially stiffened composites was demonstrated. Mechanical, electrical, and physical properties were determined experimentally. Mechanical performance was defined analytically. The hollow glass fiber composites have improved structural efficiency for applications where stiffness or compressive strength is the governing structural criterion. Author

N64-19164 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS Review of Recent Developments
J. J. English 24 Apr. 1964 3 p refs
(AD-437376)

Recent developments in oxidation-resistant coating for refractory metals are reviewed. North American has issued a report describing the procedures and equipment developed to test uncoated- and coated-foil gage materials up to 2,700° F in vacuum and in air. TRW Cr-Ti-Si coatings reduce the tensile strength of D-43 at 2,200° F, whereas the Pfaudler coating does not greatly affect the tensile strength of this alloy at 2,200° F. Tensile tests conducted on Pfaudler- and TRW-coated B-66 showed very little effect of the coating on yield strength up to 1,600° F. Creep-testing results of Pfaudler- and TRW-coated D-43 and B-66 in air at 2,000° F are presented. Recent bend-test results for coated 20-mil B-66 alloy are summarized. The Boeing fluidized-bed silicide coating was the least detrimental to the bend ductility of the B-66 substrate. Cyclic-oxidation-test results for Pfaudler- and TRW-coated B-66 are presented. Solar is developing coating-repair methods in conjunction with their foil-evaluation program. Standard Pressed Steel is evaluating refractory metal fasteners for use at high temperatures. Oxidation test results for the PFR-6 coating on 30-mil TZM sheet are given. Silicide-coating studies at Solar have illustrated that the alloy Ta-30 Nb-7.5V is more readily protected than Ta-10W. I.v.L.

N64-19175* General Electric Co., Philadelphia, Pa. Space Science Lab.
THE SYNTHESIS OF BORON CARBIDE FILAMENTS Second Quarterly Report
A. Gatti, R. Cree, E. Feingold, and R. Meehan 10 Jan. 1964 18 p refs
(NASA Contract NASw-670)
(NASA CR-53750)

Whiskers of B_4C were produced by vapor deposition and identified. The pure-vapor method rather than the dynamic-flow method was pursued throughout this phase of the program. By increasing the surface area of the B_4C refractory, the B_4C vapor in the system has been increased, leading to a 50-fold increase in the length of B_4C whiskers. Stricter control of the operating parameters is required, necessitating revisions in the furnace design. A continuing search for effective catalysts to increase the growth rate of whiskers is progressing. Studies on the morphology, orientation, crystal structure, etc., of the B_4C whiskers produced are continuing. Preliminary strength characteristics of the B_4C whiskers produced to date are being measured. Author

N64-19183 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEW GLASS FOR HIGH-VOLTAGE INSULATORS
L. A. Zhunina and N. A. Tinyakov 30 Apr. 1963 9 p refs
Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 7, 1960 p 51–55
(FTD-TT-63-256/1+2+4; AD-407936)

Glasses were obtained that were suitable, with respect to a complex of properties, for the manufacture of high-voltage insulators. Abundant and inexpensive materials serve as the raw material for these glasses. The final refinement of all characteristics and final compositions of the glasses must be carried out during the manufacturing of test batches of high-voltage insulators, under industrial conditions, on factory machinery. Author

N64-19241 Sandia Corp., Albuquerque, N. Mex.
THE EFFECT OF RADIATION ON THE MECHANICAL PROPERTIES OF POLYMERS, UNCLASSIFIED LITERATURE, 1955 TO OCTOBER, 1963
R. K. Traeger Mar. 1964 37 p refs
(SC-R-64-124) OTS: $0.75

This bibliography reviews effects due to neutron, gamma-ray, X-ray, electron, ultraviolet, and mixed radiation. The references are listed under individual polymer types. General reviews, books, and effects on dynamic mechanical properties are given separate headings. E.W.

N64-19242 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
ADDITIONAL OBSERVATIONS ON TWINNING IN SAPPHIRE (α-Al_2O_3 CRYSTALS) DURING COMPRESSION
H. Conrad, K. Janowski, and E. Stofel 10 Apr. 1964 9 p refs
(ATN-64(9236)-16)

Twinning has been found to occur in 60° oriented sapphire rods at temperatures as high as 1,500° C. The temperature and strain-rate conditions for the two types of twins, (0001) and (0111), and for slip were established in detail. R.T.K.

N64-19276 Michigan U., Ann Arbor Coll. of Engineering
THEORETICAL INVESTIGATIONS OF SCATTERING FROM PLASTIC FOAMS
M. A. Plonus Sep. 1963 36 p refs Work done in conjunction with General Dynamics/Fort Worth
(Rept. 5849-1-T)

Using foamed plastics in microwave applications, such as supports at radar ranges, requires knowledge of the back-scattering properties of these materials. Since the cell structure is random with predictable cell size and density, it is modeled by an aggregate of randomly distributed spherical shells. Assemblies of scatterers will have a coherent and an incoherent scatter. Coherent scattering comes from sudden particle density changes, and coming only from the boundaries of a constant density material, it can be reduced by shaping. Incoherent scattering results from the contribution of all the particles in the system. It represents the irreducible scattering contribution to the total back scatter, and can be considered as the minimum cross section obtainable from a foam structure if all coherent scatter has been removed. The magnitude of the incoherent scattering is illustrated by calculating radar cross sections for a styrofoam cylinder. Author

N64-19294 Bureau of Mines, College Park, Md.
X-RAY DIFFRACTION AND OPTICAL MICROSCOPIC DATA ON SEVERAL IMPORTANT PHASES IN THE BINARY SYSTEMS CaO-Al_2O_3, CaO-SiO_2, AND Na_2O-Al_2O_3
Sarkis G. Ampian 1964 58 p refs
(BM-RI-6428)

Published optical, microscopic, and X-ray diffraction characteristics of the following compounds were critically evaluated and compared with Bureau of Mines data: Tricalcium aluminate, calcium monoaluminate, dodecacalcium heptaluminate, dicalcium silicate, tricalcium silicate, and sodium aluminate. A recommended set of definitive optical and X-ray diffraction characteristics is presented. These values are used to identify products of the lime-soda-sinter process for production of alumina. Polymorphism of gamma-, beta-, and alpha-prime-dicalcium silicate is reexamined, and new data are presented on polymorphism of tricalcium silicate and sodium aluminate by high-temperature X-ray diffractometry. Polymorphism is not observed for tricalcium aluminate, calcium monoaluminate, and dodecacalcium heptaluminate. Bureau of Mines data indicating a stoichiometry of $12CaO{\cdot}7Al_2O_3$ for the phase $5CaO{\cdot}3Al_2O_3$ are discussed. A critical review of the literature concerning calcium dialuminate and sodium undecaluminate is also included.
Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-18514 Joint Publications Research Service, Washington, D.C.
THE THEORY OF PROBABILITY APPLIED
31 Mar. 1964 12 p refs Transl. into ENGLISH of 2 articles from Teoriya Veroyatnostei i ee Primeneniya (Moscow), v. 8, no. 3, 1963 p 324–330
(JPRS-23958; OTS-64-21952) OTS: $0.50

CONTENTS:
1. AXIOMATIC DEFINITION OF MATRIX GAME SIGNIFICANCE E. I. Vilkas p 1–5 refs (See N64-18515 11-20)
2. SERVICE SYSTEMS IN HEAVY WORK LOAD CONDITIONS E. G. Samandarov p 6–9 refs (See N64-18516 11-20)

N64-18515 Joint Publications Research Service, Washington, D.C.
AXIOMATIC DEFINITION OF MATRIX GAME SIGNIFICANCE
E. I. Vilkas *In its* The Theory of Probability Appl. 31 Mar. 1964 p 1–5 refs (See N64-18514 11-20) OTS: $0.50

The simplest relationships of a game, as functions of the matrix A, do not appear to be evident consequences of quantitative classical determinations. This article is devoted to the solution of the problem of axiomatic determination of the game value, by postulation of the basic properties of the function of a game with a matrix $A = \|a_{ij}\|$. R.T.K.

N64-18516 Joint Publications Research Service, Washington, D.C.
SERVICE SYSTEMS IN HEAVY WORK LOAD CONDITIONS
E. G. Samandarov *In its* The Theory of Probability Appl. 31 Mar. 1964 p 6–9 refs (See N64-18514 11-20) OTS: $0.50

A service system with a line is considered. At a load, close to the limit (at which time the stationary regime becomes impossible), the number of waiting elements and the time of entry into the system in a stationary regime are large. A mathematical means of estimating this time of entry into the system is presented. R.T.K.

N64-18559 Martin Co., Baltimore, Md.
THE DEVELOPMENT OF DIGITAL TECHNIQUES FOR THE STATISTICAL ANALYSIS OF RANDOM INFORMATION
Charles L. Pullen *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 286–290 refs (See N64-18534 11-33)

The purpose of this paper is to describe the development of a system for processing random digital data. This system is designed to incorporate a high-speed digital computer in the evaluation of the desired statistical parameters. Auto-correlation, cross-correlation, and power spectral density may be computed using this system. The data considered are taken from rocket engine noise measurements, but other types of data with similar statistical properties could be used. The data are originally recorded on an FM analog tape, and then a loop is made from a section of this tape. This loop is processed by the analog-to-digital converter, which produces a digital tape. The digital tape is used as the input data for the digital computer. For the purpose of determining the quality of the digital program, the data were analyzed. This allowed comparison of the power spectral density calculated by the digital computer and the direct band pass filter method. Author

N64-18583 Naval Ordnance Lab., White Oak, Md.
COMPLEMENTARY INEQUALITIES III: INEQUALITIES COMPLEMENTARY TO SCHWARZ'S INEQUALITY IN HILBERT SPACE
J. B. Diaz and F. T. Metcalf Apr. 1964 41 p
(NOLTR-64-26; M-46; AD-435477)

The Schwarz inequality in a Hilbert space (with real or complex scalars) implies that: $|(Ax,Bx)|^2 \leq (Ax,Ax)(Bx,Bx)$, where x is an arbitrary vector of the Hilbert space to itself. This inequality may be regarded as giving an upper bound for the number $|(Ax,Bx)|^2$ in terms of the two "squares of the norms" (Ax,Ax) and (Bx,Bx). Under certain circumstances (i.e., additional suitable hypotheses relative to the operators A and B) there exist complementary inequalities to the Schwarz inequality; that is to say, inequalities that can be regarded as giving lower bounds for $|(Ax,Bx)|^2$ in terms of (Ax,Ax) and (Bx,Bx). The purpose of the present paper is to prove operator inequalities of this general "complementary" nature. Author

N64-18589 Naval Ordnance Lab., White Oak, Md.
A FORTRAN III (IBM 7090) PROGRAM FOR THE CALCULATION OF THREE-SUBLATTICE MAGNETIZATIONS
G. Heiche 16 Jan. 1964 29 p
(NOLTR-63-32; Math. Dept. Rept. M-35; AD-434924)

For a given set of molecular field coefficients the program calculates the total and partial magnetizations as a function of temperature. It is assumed that the molecular field coefficients vary linearly with temperature. Up to 1,000 values can be calculated for each magnetization at equidistant temperatures. A complete listing of the subroutines and an example are included. Author

N64-18619 Brown U., Providence, R.I. Div. of Applied Mathematics
REPRESENTATION THEOREMS IN THE MECHANICS OF MATERIALS WITH MEMORY
Rafael V. S. Chacon and Ronald S. Rivlin Feb. 1964 10 p refs
(Contract Nonr-562(10))
(C11-89; AD-434704)

It is shown how the Stone–Weierstrass theorem can be used to obtain constitutive equations for materials with memory that possess some symmetry in their reference state.
Author

N64-18620 Stanford U., Calif.
PROBLEMS IN PROBABILITY OF A GEOMETRIC NATURE
Bradley Efron 1 Apr. 1964 69 p refs
(Contract Nonr-225(52))
(Tech. Rept. 97; AD-434208)

The following problems dealing with geometric probability are discussed: (1) geometric probability on the hypersphere; (2) optimum evasion versus systematic search; (3) increasing properties of Polya frequency functions; and (4) a simultaneous test for sample correlations. P.V.E.

N64-18728* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
AN OPTIMIZED PRINTER PLOTTING SYSTEM CONSISTING OF COMPLEMENTARY 7090 (FORTRAN) AND 1401 (SPS) SUBROUTINES PART I – INSTRUCTIONS FOR USERS
Lois T. Dellner and Betty Jo Moore Washington, NASA, Apr. 1964 31 p ref
(NASA TN D-2174) OTS: $0.75

An inexpensive way of obtaining printed plots from a 7090-1401 computer system is described. This method makes use of the printer attached to the 1401 computer as the plotter. Also contained in this report are 12 examples of the plots obtainable using the OPP system (Optimized Printer Plotting). Author

N64-18729* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
AN OPTIMIZED PRINTER PLOTTING SYSTEM CONSISTING OF COMPLEMENTARY 7090 (FORTRAN) AND 1401 (SPS) SUBROUTINES. PART II: SYSTEMS PROGRAMMERS MANUAL
Lois T. Dellner and Betty Jo Moore Washington, NASA, Apr. 1964 114 p refs
(NASA TN D-2175) OTS: $2.50

The OPP system (Optimized Printer Plotting), a set of complementary subroutines for the IBM 7090 and 1401, is a simple-to-use system that requires minimum storage, reduces 7090 execution time (by a factor of more than 10 from that required by presently available machine plotting methods), and produces printed plots at full printer speed (6 sec/page) as part of normal off-line output. This optimization is achieved by combining three techniques: (1) performing most of the requisite arithmetic on the 7090, (2) packing the results on the output tape, (3) having the 1401 generate the grid and the grid-labels, as well as position the points in a subroutine of the standard tape-to-printer program. Author

N64-18775 University of Southern California, Los Angeles
EVALUATION OF COMPLEX ORDER HANKEL FUNCTIONS
Cavour W. H. Yeh Jan. 1964 34 p refs
(Contract AF 19(604)-6195)
(AFCRL-64-96; USCEC-82-215; EE-33; AD-434113)

Computation of the complex order Hankel function $H_\nu(z)$ and its derivative $d/dz\ H_\nu(z)$ was carried out. Results are tabulated to four significant figures for $0.1 \leq x \leq 1.0$, $0 \leq y \leq 1.0$, and $0.1 \leq z \leq 5.0$, where $\nu = x + iy$. Author

N64-18784 Stanford Research Inst., Menlo Park, Calif.
A MATHEMATICAL MODEL OF A TWO-LAYER NETWORK OF THRESHOLD ELEMENTS
Donna J. Kaylor Griffiss AFB, N.Y., RADC, Mar. 1964 38 p refs
(Contract AF 30(602)-2943)
(RADC-TDR-63-534; AD-434767)

This paper deals with two facets of the committee problem; i.e., the problem of determining the values of the two sets of weights in a two-layer learning machine consisting of threshold elements so as to classify correctly a set of patterns into two categories, where the first-layer weights are considered committee members, and the second layer is considered the committee solution. The first facet involves the existence of a solution committee and the description of various properties of a solution committee. The second facet involves finding an algorithm for locating the members of a solution committee and assigning an evaluation to the vote for each member. As yet, no satisfactory algorithm is known for simultaneously locating committee members and assigning weights to their votes. Author

N64-18787 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
FURTHER STUDIES OF MULTIPLE REGRESSION ANALYSIS OF HUMAN PILOT DYNAMIC RESPONSES: A COMPARISON OF ANALYSIS TECHNIQUES AND EVALUATION OF TIME-VARYING MEASUREMENTS
Jerome I. Elkind Wright-Patterson AFB, Ohio, Flight Control Div. Mar. 1964 168 p refs
(Contract AF 33(657)-8224)
(ASD-TDR-63-618; AD-435686)

The paradigm of multiple regression analysis is used as a basis for comparing four-system identification techniques commonly used to determine human pilot describing functions: cross-correlation analysis, cross-power density spectrum analysis, orthogonalized exponential function analysis, and differential equation coefficient methods. Relations for the expected values and variances of the measurements obtained using these methods are derived. The relative advantages of these methods for long and short sample measurements are discussed. A method for computing estimates of the coefficients of the differential equation for the human pilot from the regression coefficients obtained from the orthogonalized exponential analysis method is presented. Two methods for determining time-varying describing functions are presented: ensemble methods and quasi-stationary methods. Author

N64-18873 New York U., N.Y. Courant Inst. of Mathematical Sciences
AUTOMORPHIC FORMS AND POINCARE SERIES FOR FINITELY GENERATED FUCHSIAN GROUPS
Lipman Bers Feb. 1964 30 p refs
(Contract DA-ARO(D)-31-124-G156)
(IMM-NYU-318; AROD-247-58; AD-434159)

Let D be a simply connected domain in the extended complex plane, with at least two boundary points, and G a discrete group of conformal self-mapping $z \rightarrow A(z)$ of D. If q is a fixed integer, then the automorphic form of weights $(-2q)$ is a holomorphic solution of the functional equation $\phi(A)\ (z)\ A'\ (z)^q = \phi(z)$ for z in D and A in G. In addition it is assumed that $\phi(z) = O(|z|^{-2q})$, $z \rightarrow$ as if $\frac{1}{z}$ is in D. The Banach spaces of integrable forms (using the Poincaré metric) and of bounded forms, and the Peterson scalar product connecting their elements lead to several theorems on the forms ϕ, including several dealing with the Eichler class when ϕ is an integrable form. Author

N64-18881 North Carolina State Coll., Raleigh
THE CONSTRUCTION OF PERIODIC SOLUTIONS OF NONLINEAR OSCILLATORS Technical Report No. 1
J. H. Heinbockel and Raimond A. Struble Mar. 1964 91 p refs
(Contract DA-ARO(D)-31-124-G450)
(AROD-4105-6; AD-434453)

Considered are periodic solutions of $X_{||} + g(x) = F(t)$, where F(t) is periodic. Normal trajectories, or trajectories in the phase plane that cut a line through the origin twice, are shown to be periodic in certain circumstances. Their existence is established by geometrical reasoning, and simple continuity arguments establish periodicity. The avoidance of implicit function techniques removes certain restrictions associated with perturbational theories. Author

N64-18913 Technische Hochschule Hannover (W. Germany) Institut für Mechanik
INVESTIGATION OF PLATE AND SHELL MODELS BY MATRICES
Eduard Pestel [1963] 74 p refs
(AF EOAR Grant 61-46)
(AD-434846)

The purpose of this report is to develop grid methods of such variety that it is possible to construct substitute systems approximating almost any shape of disc, plate, or shell. Grid models are developed for arbitrary triangular and trapezoidal shapes, and the effect of shear deformation is included in bending problems. A straightforward method is derived for the application of Hrennikoff's models to cylindrical shells. Also, a concise method for the derivation of the stiffness matrix for Hrennikoff's model is developed. In addition, the following are discussed: basic problems concerning the lumped-parameter technique that is ordinarily employed in conjunction with grid models for vibration problems; the proposal to deal with the case of random vibrations via the frequency response of the structure, which is obtained by transfer matrix methods; and the use of transfer matrices for problems in dynamic stability. I.v.L.

N64-18926 California U., Berkeley Operations Research Center
NOTES ON OPERATIONS RESEARCH – 2
27 Sep. 1963 29 p refs
(Contract Nonr-222(83))
(ORC-63-23(RN-4); AD-434782)

CONTENTS:

1. GEOMETRIC INTERPRETATION OF DANTZIG'S CONVEX PROGRAMMING ALGORITHM P. Huard p 1–12 refs (See N64-18927 11-20)
2. THE PROBLEM OF THE MAXIMUM FLOW IN TRANSPORTATION WITH CORRESPONDING CONSTRAINTS A. Ghouila-Houri (Natl. Soc. French Railways) p 14–24 (See N64-18928 11-20)
3. A TECHNIQUE FOR RESOLVING DEGENERACY IN LINEAR PROGRAMMING G. B. Dantzig p 26–27 (See N64-18929 11-20)

N64-18927 California U., Berkeley Operations Research Center
GEOMETRIC INTERPRETATION OF DANTZIG'S CONVEX PROGRAMMING ALGORITHM
Pierre Huard *In its* Notes on Operations Res. 2 27 Sep. 1963 p 1–12 refs (See N64-18926 11-20)

The following program is considered:

$$\text{PI} \begin{cases} \text{Find } x \epsilon R \text{ such that } \phi_0(x) \text{ is maximum} \\ \text{subject to } \phi_i(x) \geq 0 \text{ for } i = 1, 2, \ldots, m. \end{cases}$$

PI is replaced by a linear program PII-K that gives a lower approximate solution $\phi_0(x)$ for PI. This linear program is constructed from a finite number of points $x = X^j$, $j \epsilon K$ that belong to R. The following auxiliary program is also solved:

$$\text{PIII-K} \left| \begin{array}{l} \text{Find } x \epsilon R \text{ such that} \\ \sum_{i=1}^{m} \bar{x}^j \phi_i(x) + \phi_0(x) \text{ is maximum.} \end{array} \right.$$

The geometric interpretation of PII and PIII is included. R.T.K.

N64-18928 Societe Nationale des Chemins de Fer Francais Paris (France)
THE PROBLEM OF THE MAXIMUM FLOW IN TRANSPORTATION WITH CORRESPONDING CONSTRAINTS
A. Ghouila-Houri *In* Calif. U., Berkeley Notes on Operations Res. 2 27 Sep. 1963 p 14–24 Transl. into ENGLISH from Proc. of 2nd Intern. Conf. on Operational Res, Aix-en Provence, France, 1960 (See N64-18926 11-20)

A transportation network, in which there is a two-way correspondence between entry and exit arcs, is considered. The maximum flow was obtained by applying the Ford–Fulkerson algorithm to a sequence of networks, each of which is obtained from the labeling of the preceding network. R.T.K.

N64-18929 RAND Corp., Santa Monica, Calif.
A TECHNIQUE FOR RESOLVING DEGENERACY IN LINEAR PROGRAMMING

George B. Dantzig *In* Calif. U., Berkeley Notes on Operations Res. 2 27 Sep. 1963 p 26–27 Rev. by Philip Wolfe in J. Soc. Indust. Appl. Math., v. 11, 1963 p 205–211 Submitted for Publication (See N64-18926 11-20)

The geometry of the simplex method for solving a linear program is discussed. Geometrically, this method passes iteratively from one extreme point to a selected neighbor in a convex polyhedral set. If the set is defined by a system of m linear equations in n nonnegative variables, then algebraically, an extreme point solution E is obtained if, setting n – m variables equal to zero, there is a unique nonnegative solution in the remaining "basic" set of m-variables. If the same extreme point E corresponds to more than one basic set, the solution is called "degenerate." In this case, the value of linear "objective" form (to be minimized) may not decrease from iteration to iteration. Several special selection rules for successively choosing basic sets have been proposed to guarantee, under degeneracy, termination in a finite number of steps. Dantzig's inductive proof of the simplex method is also discussed. R.T.K.

N64-18939 Lockheed Missiles and Space Co., Palo Alto, Calif.
RESEARCH ON AUTOMATIC COMPUTER ELECTRONICS. VOLUME I: COMPUTER DEVICE AND CIRCUIT RESEARCH Final Report, 1 Sep. 1962–1 Oct. 1963
Richard I. Tanaka et al Wright-Patterson AFB, Ohio, Res. and Tech. Div., Feb. 1964 345 p refs
(Contract AF 33(657)-8777)
(RTD-TDR-63-4173, Vol. 1; AD-435780)

The computer device and circuit research work includes a phenomena survey intended to develop possible new directions for later research. The information is presented both as short descriptions of the various phenomena, and also as summary lists developed from punched-card abstracts. Experiments in the solid-state physics area are described that have resulted in the following devices or designs: (1) a ternary logic element, (2) the design of a ternary threshold element, (3) a cryogenic ternary storage elements, (4) the design of a memory array using ternary storage elements, and (5) the design of a variable gain threshold element. The descriptions of the work on ferrite logic include discussion of various single-unit flux-steered ferrite devices, as well as experimental results obtained in performing selected parallel logic operations. Author

N64-18940 Lockheed Missiles and Space Co., Palo Alto, Calif.
RESEARCH ON AUTOMATIC COMPUTER ELECTRONICS. VOLUME II: LOGICAL DESIGN RESEARCH Final Report, 1 Sep. 1962–1 Oct. 1963
Richard I. Tanaka et al Wright-Patterson AFB, Ohio, Res. and Tech. Div., Feb. 1964 293 p refs
(Contract AF 33(657)-8777)
(RTD-TDR-63-4173, Vol. 2; AD-436349)

Two major topics are covered: threshold logic and ternary logic. The description of threshold logic includes theoretical results usable for synthesizing threshold functions by means of orthogonal expansions, Boolean techniques, or decomposition methods. Design techniques that consider constraints imposed by practical circuit considerations are also described, along with the assumptions that define the constraints. The work on ternary logic is intended to be a prelude to later extension to p-valued logic. The two major approaches followed are: (1) deriving suitable ternary algebra systems that include properties desirable for minimizing logic expressions, and (2) devising methods for expressing ternary functions in forms suitable for implementation by ternary elements. Author

N64-18964 Joint Publications Research Service, Washington, D.C.
INHIBITOR CIRCUITS, RATE CONTROL DEVICES AND COMPILERS
6 Apr. 1964 50 p refs Transl. into ENGLISH of 3 articles from Zh. Vychislitel'noy Mat. i Mat. Fiz. (Moscow), v. 4, no. 1, Jan.–Feb. 1964 p 52–60, 78–95, 113–119
(JPRS-24055; OTS-64-21999) OTS: $1.25

CONTENTS:

1. A COMPILER V. A. Popov, V. A. Stepanov, A. G. Stisheva, and N. A. Travnikova p 78–95 refs

2. NUMERICAL METHOD OF CALCULATING OPTIMUM RATE CONTROL FOR LINEAR SYSTEMS B. N. Pshenichnyy p 52–60 refs

3. THE CONSTRUCTION OF AN INHIBITOR CIRCUIT IN AN OPERATOR SCHEMATIC WITH REFERENCES TO THE LIBRARY Yu. I. Smirnov p 113–119 refs

N64-18983 California U., Livermore, Lawrence Radiation Lab.
PROCEDURES FOR DIGITAL COMPUTER ANALYSIS OF ONE-DIMENSIONAL FLUID FLOW PROCESSES INVOLVING REAL GASES
Michael D. Mintz and Duane P. Jordan 15 Jan. 1964 52 p refs
(Contract W-7405-ENG-48)
(UCRL-7530) OTS: $1.00

A discussion is presented regarding the use of real gas property data (i.e., data characterized by temperature and pressure dependence) in the analysis of one-dimensional, compressible, fluid flow problems. In particular, methods are suggested for the mathematical treatment of several commonly encountered processes, including isentropic flow, the generalized flow process (of which the Rayleigh and Fanno lines are special cases), and subsonic and supersonic flow through real nozzles. The philosophy of calculation is graphically demonstrated by means of simple logic flow diagrams. Special emphasis is placed upon the use and interpretation of tabular gas property data. Author

N64-19053 Stanford Research Inst., Menlo Park, Calif.
CLASSIFICATION AND GENERALIZATION CAPABILITIES OF LINEAR THRESHOLD UNITS
Thomas M. Cover Griffiss AFB, N.Y., RADC, Feb. 1964 23 p refs
(Contract AF 30(602)-2943)
(RADC-TDR-64-32; AD-436347)

In a d-dimensional binary space, there exists n separate points ($N = 2^d$) and 2^N possible combinations (dichotomy) of these points. Not all of these combinations can be separated by linear threshold functions. Discussed are the combinations that can or cannot be separated. Surfaces other than hyperplanes are also studied, including surfaces obtained by multiple linear threshold devices and quadratic surfaces. Consideration is given to training procedures in the separation of random patterns by linear threshold devices. Author

N64-19054 California U. Berkeley. Operations Research Center
ON A PROBLEM OF OPTIMUM PRIORITY CLASSIFICATION
Robert M. Oliver and Gerold Pestalozzi 30 Dec. 1963 26 p refs
(Contract Nonr-222(83); NSF Grant 21034)
(ORC 63-29(RR); AD-434807)

This article is concerned with the improvement of a customer-service system by segregation of the customers into priority classes. Consideration is given the extreme case in

which the service time of a customer is known exactly from the moment the customer joins the queue of the service facility. The following problem is proposed. With a fixed number of priority classes, how should priorities be assigned to customers in order to minimize expected queueing time of all the customers using the service system. It is shown that this decision problem can be formulated in terms of a nonpreemptive priority queueing model, and that the mathematical optimization can be expressed as a functional equation involving two variables—the number of priority classes, and the truncation point that separates two priority classes. C.L.W.

N64-19063 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
AN EXPERIMENTAL COMPARISON OF THREE LEARNING MACHINE TRAINING RULES
Nils J. Nilsson and Richard C. Singleton (Stanford Res. Inst.) Griffiss AFB, N.Y., RADC, Feb. 1964 17 p refs
(Contract AF 30(602)-2943)
(RADC-TDR-64-33; AD-436297)

This report includes the results of a series of experiments to compare the efficiency of training methods using (1,0) and (+1,−1) representatives for patterns. It also presents a theoretical explanation that deals with a single threshold logic unit (TLU) rather than with a network of TLU's as used in the experiments. The effects noted, however, can be expected to pertain to the network also. Author

N64-19092 Boeing Scientific Research Labs., Seattle, Wash.
OPTIMUM REDUNDANCY UNDER MULTIPLE CONSTRAINTS
Frank Proschan and T. A. Bray May 1963 25 p refs
(Math. Note 298; D1-82-0253)

An algorithm is developed to solve the more general problem of maximizing system reliability without exceeding any of several linear constraints. Specifically, a system consisting of k "stages" is considered. The system functions if and only if each stage functions. I.v.L.

N64-19099 Iowa State U. of Science and Tech., Ames
FORTRAN PROGRAMS FOR THERMAL DIFFUSIVITY CALCULATIONS
Arthur H. Klein Feb. 1964 19 p refs
(Contract W-7405-ENG-82)
(IS-833) OTS: $0.50

FORTRAN programs have been written for the IBM 7074 to analyze thermal diffusivity data taken by a linear, finite-rod method and a radial, stacked-disk method. The linear technique records data from three thermocouples attached to a rod surrounded by a concentric radiation shield of the same material. Sample and shield are joined at one end, and an electrical heater is attached to that end. The radial method employs three thermocouples placed along radii of the sample disk and an axial heater through the disk. The information from the first and third thermocouples is used to calculate a set of points for the second thermocouple for an estimate of the thermal diffusivity. The calculated and experimental values for the second thermocouple are then compared. A series of calculations are made for different diffusivity estimates, and that diffusivity estimate giving the best agreement between the calculated and experimental values is taken as the thermal diffusivity for that set of data. Author

N64-19108 Lincoln Lab., Mass. Inst. of Tech., Lexington
DATA SYSTEMS Quarterly Progress Rept., 1 Nov. 1963-31 Jan. 1964
F. C. Frick and S. H. Dodd 15 Feb. 1964 22 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-31; AD-432495)

The current status of research in the following areas is reported: (1) digital computers, which includes the TX-2 and the arithmetic-element test unit computer systems, circuit development, magnetic film engineering, computer design aids, and an executive system translator; (2) computer components, which includes electron transport, magnetic films, and advanced circuits; (3) psychology, which includes an automatic procedure executor, automatic speech recognition, and human information processes; and (4) control research, which includes the on-line use of computers, estimation and control theory, and a digital monopulse data processor. I.v.L.

N64-19115 Cook Electric Co., Morton Grove, Ill. Tech. Center Div.
DEVELOPMENT OF TECHNIQUES FOR PREDICTION OF SYSTEM EFFECTIVENESS Final Report
T. J. Horrigan 28 Feb. 1964 123 p refs
(Contract AF 30(602)-2718)
(RADC-TDC-63-407; AD-432844)

Prediction of system effectiveness was investigated to determine the mathematics, mathematical models, or mathematical procedures capable of supporting the required applications. Special attention was given to problems in which the computation of effectiveness indices must consider reliability and maintainability. Feasible solutions exist only in terms of hybrid Monte Carlo and analytical simulation programs for digital computers (requiring, in some cases, minor analog support) to be generated by the computer itself by virtue of a compiler-type automatic programing language. The existing languages are inappropriate because of the lack of suitable logic, protracted programing time, or lack of usability by other than specially trained programers. Difficulties encountered are demonstrated by the construction of a working program for the prediction of effectiveness for a simple system in which reliability and maintainability are considered. Suggestions for the structure of a suitable language are set forth. Author

N64-19121 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
TEMPERATURE DISTRIBUTION IN A SYSTEM OF SOLID BODIES IN CONTACT VIA A THIN INTERMEDIATE LAYER
Ya. S. Podstrigach 24 Mar. 1964 10 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., (Minsk), v. 6, no. 10, 1963 p 129–136
(RSIC-148; AD-436200)

A new approach is presented for calculations on thermal contact between solids. Solutions are given for the one-dimensional transient transfer between two plates and for the two-dimensional case of a space with a cylindrical inclusion subject to a specified steady uniform flux at infinity. Author

N64-19192 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FUNDAMENTALS OF THE GENERAL THEORY OF QUASI-ANALOG SYSTEMS
G. Ye. Pukhov 22 Jan. 1963 35 p refs Transl. into ENGLISH from Izv. Vysshikh. Uchebn. Zavedenii, Elektromekhan. (Novocherkassk), no. 9, 1961 p 3–21
(FTD-TT-62-1557/1+2+4; AD-298210)

The special feature of quasi-analog systems is that the equations of the simulator and the equations of the simulated object are not similar. The criteria, which permit the mathematical equivalence of object and model to be assessed in this

mathematically dissimilar systems, are called equivalence tests. The simulated object may be described by algebraic, differential, integral, or other equations, after certain assumptions are made. The only mathematical models considered are models of the corresponding equations, not the models of the object. Thus, the concept of the quasi-analog models can be formulated as follows: A quasi-analog model of equations (a) is an analog model of other equations (b), at least partly dissimilar to the given equations and such that, when certain conditions—equivalence tests—are fulfilled, all or some of the unknowns of equations (b) will coincide with the unknowns of the initial equations (a). There are two kinds of quasi-analog models—nonequilibrated and equilibrated models. Only the equilibrated model is categorized with systems that include feedbacks. These feedbacks are in the form of equilibration systems. I.v.L.

N64-19201 Uppsala U. (Sweden) Quantum Chemistry Group
INDUCED REPRESENTATIONS WITH APPLICATIONS TO THE SYMMETRIC AND FULL LINEAR GROUPS
A. J. Coleman 1 Jul. 1963 57 p refs
(Contract AF 61(052)-351)
(Tech. Note 102; ARL-63-247; AD-434666)

A simple, general outline of induced representations in group theory is reviewed. The discussion is restricted to finite dimensional representations. However, many of the theorems are valid for infinite dimensional representations. In order to admit representations of continuous groups, following Mackey, a definition of induced representation is given in terms of functions that have as domain the coset space G/H rather than the group G. R.T.K.

N64-19202 Uppsala U. (Sweden) Quantum Chemistry Group
REDUCTION OF FERMION OPERATORS BY LITTLE GROUP TECHNIQUE Scientific Report No. 6
I. V. V. Raghavacharyulu 15 Dec. 1963 11 p refs
(Contract AF 61(052)-701)
(Preprint 111; ARL-64-79; AD-436703)

The representations of the Fermion operators are obtained by the little group technique, which reduces the important theorems on their matrix representations to the well-known theorems on the representation of groups. Author

N64-19219 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPROXIMATE SOLUTION OF DIFFERENTIAL EQUATIONS WITH DEVIATING ARGUMENTS
N. V. Sharkova 10 Feb. 1964 17 p refs Transl. into ENGLISH from Izv. Vysshikh Ucheb. Zavedenii, Mat. (Moscow) no. 3, 1963
(FTD-TT-63-1034/1+2+4; AD-433528)

The method of oscillating functions is applied to the approximate solution of both linear and nonlinear differential equations of the leading argument type and of the neutral type. P.V.E.

N64-19228 Academia Republicii Populare Romine, Bucharest (Rumania)
PROJECTIVE DIFFERENTIAL GEOMETRY. CORRESPONDENCE THEORY [GEOMETRIE DIFERENTIALA PROIECTIVA TEORIA CORESPONDENTEI]
Tiberiu Mihailescu 1963 239 p refs in RUMANIAN

This paper is a monograph on projective differential geometry that includes chapters on the complex plane, triple systems of nonholonomic variables, correspondence theory, and 72 references. P.F.E.

N64-19232 Academia Republicii Populare Romine, Bucharest (Rumania) [Comisia de Automatizari]
LATTICE AXIOMS FOR BOOLEAN ALGEBRAS [AXIOMELE LATICILOR SI ALE ALGEBRELOR BOOLEENE]
Sergiu Rudeanu 1963 159 p refs in RUMANIAN

This paper is a monograph on lattice axioms for Boolean Algebra. Included are chapters on partially ordered sets, lattices, modular lattices, distributive lattices, other categories of partially ordered sets, and 164 references. P.F.E.

N64-19256* Control Data Corp., Minneapolis, Minn. Aerospace Research
COMPUTER REQUIREMENTS: DATA CONSTRUCTION, INPUT, AND INITIAL PROCESSING. FEASIBILITY STUDY OF A TRACK-WHILE-SCAN NAVIGATION CONCEPT
Joseph E. Carroll 8 Nov. 1963 38 p refs
(NASA Contract NAS1-2902)
(NASA CR-53515; CDC-TM-9552-7) OTS: $3.60 ph

A discussion is presented of the detection process wherein information passes successively through the camera slits, photomultiplier, transmitter, receiver, and electronics buffer, and finally comes to rest in the computer memory. Two signals are actually processed—phototube anode current and multiplier voltage. The first is used to measure entrance and exit times of the target image in the slits. The multiplier voltage changes with target intensity to protect the tube and is therefore useful as an intensity indicator. R.T.K.

N64-19259* National Institutes of Health, Bethesda, Md.
Final Report [ESTABLISHMENT AND OPERATION OF A REGIONAL RESEARCH CENTER AT MIT FOR COMPUTER TECHNOLOGY AND RESEARCH IN BIOMEDICAL SCIENCES]
W. A. Clark (MIT) et al 29 Oct. 1963 158 p refs
(NASA Order R-78; Contract PH43-63-540)
(NASA CR-53599) OTS: $11.50 ph

Primary functions of the New England Center for Computer Technology and Research in the Biomedical Sciences would be to: (1) conduct research in computer technology and to develop computer systems appropriate to problems in the biological and medical sciences; and (2) conduct coherent research programs in those areas of the biological and medical sciences in which the life scientists and the computer scientists involved have overlapping interests. The scope of operations, organizational structure, problems of interdisciplinary research, and the service aspects of the Center are discussed. The Center would operate a number of special computer facilities, eventually including a new, large computer system of the TX-2 variety, as well as intermediate-size computers, and small laboratory-instrument computers such as LINC. It would also develop and maintain special biological facilities and equipment essential to the research programs. A description of LINC and the LINC Evaluation Program is appended, including the teaching materials used for training participants in the program. R.L.K.

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-18526 Joint Publications Research Service, Washington, D.C.
CYCLIC SOLAR ACTIVITY AND WEATHER FORECASTING

Moris Semenovich Eygenson 13 Apr. 1964 40 p Transl. into ENGLISH of two chapters from the book "Solntse, Pogoda i Klimat," Leningrad, 1963 p 46–64 and 130–149
(JPRS-24167; OTS-64-31068) OTS: $1.00

CONTENTS:

1. INFLUENCE OF SOLAR ACTIVITY ON THE EARTH'S ATMOSPHERE M. S. Eygenson p 1–18 (See N64-18527 11-21)

2. SOLAR ACTIVITY, ATMOSPHERIC RHYTHMS, AND LONG-RANGE WEATHER FORECASTING M. S. Eygenson p 19–37 (See N64-18528 11-21)

N64-18527 Joint Publications Research Service, Washington, D.C.

INFLUENCE OF SOLAR ACTIVITY ON THE EARTH'S ATMOSPHERE

Moris Semenovich Eygenson *In its* Cyclic Solar Activity and Weather Forecasting 13 Apr. 1964 p 1–18 (See N64-18526 11-21)

A survey is made of studies relating fluctuations in solar activity with various phenomena. The effect of solar activity on the ionosphere, the ozonosphere, perturbations in the geomagnetic field, night airglow, meteoric processes, cosmic radiation, solar radioemission, and other planets and comets are investigated. E.W.

N64-18528 Joint Publications Research Service, Washington, D.C.

SOLAR ACTIVITY, ATMOSPHERIC RHYTHMS, AND LONG-RANGE WEATHER FORECASTING

Moris Semenovich Eygenson *In its* Cyclic Solar Activity and Weather Forecasting 13 Apr. 1964 p 19–37 (See N64-18526 11-21)

A survey is presented of studies made to determine relationships between solar activity and atmospheric rhythms for the purpose of long-range weather forecasting. A model explaining the periodicity of atmospheric processes due to the rhythm of solar activity is described in detail, and correlations between various atmospheric parameters and solar activity are listed. E.W.

N64-18697 Air Weather Service, Washington, D.C.

UPPER-STRATOSPHERE DENSITY AND TEMPERATURE VARIABILITY DETERMINED FROM METEOROLOGICAL ROCKET NETWORK RESULTS, 1960-1962

R. S. Quiroz, J. K. Lambert, and J. A. Dutton Dec. 1963 48 p refs
(AWS-TR-175; AD-431703)

A sample of 256 rocket temperature profiles, mainly from 1960 through 1962, was examined critically, and density profiles at altitudes below 180,000 ft (54.9 km) were derived. It is indicated that: (1) The natural seasons with respect to density do not coincide with the natural seasons with respect to temperature. (2) The interdiurnal variability of density increases with altitude at least to 150,000 ft (45.7 km), whereas this variability of temperature appears to reach a maximum near 130,000 ft (39.6 km). The interdiurnal variability of both density and temperature in the middle latitudes can equal or exceed the values in high latitudes. (3) Large horizontal density gradients between middle and high latitudes are not expected in the upper stratosphere. Gradients of the order of 1%/degree latitude are possible, but gradients of more than a few percent/degree are unlikely. (4) The magnitude of vertical gradients generally decreases with altitude at 100,000 to 180,000 ft (30.5 to 54.9 km). However, this conclusion is not necessarily true above 180,000 ft. In addition, routine statistics, such as the means, extremes, and standard deviations of density and temperature, are given for individual stations, and 1, 10, 90, 99 percentiles, mean values of density and temperature, standard deviations, and correlation coefficients are given for all stations combined. I.v.L.

N64-18746 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

COMPENSATION PHOTOMETER FOR ACCURATE MEASUREMENTS AND REGISTRATION OF TRANSPARENCY OF ATMOSPHERE

V. I. Goryshin 12 Jul. 1963 31 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 118, 1961 p 26-41
(FTD-MT-63-15/1+2; AD-434950)

Compensation photometers for the measurement and registration of atmospheric transparency are reviewed, and the main sources of errors are considered. A compensation photometer for accurate measurements of this transparency is described that employs a new method of light-beam modulation, namely, modulation during the rotation of the modulator disc. The diaphragm is a linear measuring diaphragm. I.v.L.

N64-18747 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PECULIARITIES OF OPTICAL CHARACTERISTICS OF ARCTIC MASSES OF AIR

N. I. Nikitinskaya 12 Jul. 1963 9 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 118, 1961 p 77-81
(FTD-MT-63-17/1+2; AD-434938)

Spectrometric characteristics of Arctic air masses in the Leningrad area were investigated. Observations were conducted during the near-noon hours for various days of July, August, September, and October 1951. The coefficients of spectral transparency of the thickness of the atmosphere were calculated, and the intensity of solar light in a given spectral region, pierced by solar-beam atmospheric masses, was determined. It is indicated that: (1) High constancy of the values of the coefficient of spectral transparency of the thickness of the atmosphere was obtained in the cases of pure Arctic air. Aerosol particles lead to neutral scattering of light. (2) The magnitude of the intensity of solar light in a given spectral region, pierced by solar-beam atmospheric masses, observed in Arctic air masses was significantly different from corresponding magnitudes of other air masses in more shortwave regions. I.v.L.

N64-18767 Emmanuel Coll., Boston, Mass. Research Language Center

DIAGRAMS FOR ESTIMATING THE APPLICABILITY OF CHIMNEY HEIGHTS TO AIR PURIFICATION CONDITIONS [DIAGRAMME ZUR BEURTEILUNG DER EIGNUNG VON SCHORNSTEINHOHEN FUR DIE LUFTREINHALTUNG]

F. Wippermann (Darmstadt Tech. Hochschule) Bedford, Mass. AFCRL [Sep. 1963] 46 p refs Transl. into ENGLISH from GERMAN
(Contract AF 19(604)-8505)
(E-T-G-63-27; AD-430981)

Diagrams are presented that allow statements concerning the maximum of the surface concentration of harmful gases emitted, the frequency of their height and position, and the fixed, greatest permissible value. The prerequisite for the construction of these diagrams is that the frequency distribution of the wind velocity be considered as the most important meteorological parameter in the diffusion theory. I.v.L.

N64-18781 Little (Arthur D.), Inc., Cambridge, Mass.

INFRARED SPECTRAL PROPERTIES OF HIGH-ALTITUDE CLOUDS Technical Report No. 2

H.H. Blau, Jr., E. M. Duchane, R. P. Espinola, E. C. Reifenstein, III, P. C. von Thuna et al Dec. 1963 93 p refs
(Contract Nonr-3556(00))
(AD-428979)

This report describes the results of an experimental program concerned with the measurement of the spectral scattering properties of sunlit clouds, at altitudes above 30,000 feet, in the 2.3- to 3.7-micron region. Spectra were obtained, using a Perkin-Elmer Model SG-4 rapid-scan-grating spectrometer mounted in a U-2 aircraft, for a variety of cloud types as a function of cloud altitude and scattering angle. Measurements indicate that clouds may be classified according to their optical density. Both opaque and semitransparent clouds backscatter infrared radiation very inefficiently throughout the 2.3- to 3.7-micron region, in marked contrast to the high scattering efficiency that is observed in the visible region. The effective diffuse reflectance reaches a maximum value of a few percent at 2.3 microns, falls to values as low as a few thousandths of a percent in a pronounced minimum in the 2.7- to 2.9-micron region, and rises to a few tenths of a percent at longer wavelengths. The position of the minimum is a relatively strong function of cloud opacity. Scattering power increases with decreasing scattering angle. This effect is largest in spectral regions where the ice crystals or water droplets, of which the clouds are composed, are quite opaque, and multiple scattering is, consequently, unimportant. I.v.L.

N64-18848 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
FORMATION OF LAKE ICE IN A TEMPERATE CLIMATE
Richard H. Ragle Aug. 1963 29 p refs
(CRREL Res. Rept. 107; AD-433794)

The formation of lake ice in a temperate continental climate was studied during the winter of 1956–1957 at Post Pond, Lyme, New Hampshire. In the 36 blocks of ice studied, 4 textures and 3 structures were observed. The textures, tabular, columnar, granular, and crenulate are discussed in terms of relative growth velocity. The structures were Forel striations, Tyndall figures, and bubbles. Strain shadows, a structural feature, were also observed. The average crystal area increased with increasing ice thickness. Generally the rate of increase was greater toward the center of the lake. However, within a pronounced bubble layer, which was continuous through a horizontal plane in the lake-ice sheet, the average crystal area ceased to enlarge. Author

N64-18895 Texas A. and M. Research Foundation, College Station
TIME CHANGES IN CLOUDS AS SHOWN BY TIROS OBSERVATIONS OVER THE GULF OF MEXICO AND CARIBBEAN SEA DURING THE PERIOD 18-23 JULY 1961 Scientific Report No. 4
William P. Cramer and Aylmer H. Thompson 1 Jan. 1964 64 p refs
(Contract AF 19(604)-8450)
(AFCRL-64-235; AD-435824)

Analyses using conventional data and meteorological satellite data from TIROS III were used to identify and follow cloud systems. Isopleths of relative humidity were used to identify moist air on constant pressure charts. Regions described as "dry" by the relative humidity analysis, especially at 700 and 500 mb, had insignificant cloud amounts. When the "dry" area included the 850 mb level, the TIROS pictures always indicated fair weather skies. Large values of relative humidity were not always a reliable indication of cloud cover. Author

N64-18896 Texas A. and M. Research Foundation, College Station
INVESTIGATION OF RADIATION PATTERNS IN THE 8-12 MICRON RANGE AS OBSERVED BY TIROS III OVER THE CARIBBEAN SEA DURING THE PERIOD 20-21 JULY 1961 Scientific Report No. 5
Paul I. Mohler and Aylmer H. Thompson 1 Feb. 1964 42 p refs
(Contract AF 19(604)-8450)
(AFCRL-64-236; AD-435823)

Two cases of infrared radiation measurements in the 8μ to 12μ range are studied in this report. The radiation readings are related to cloud patterns and surface temperatures in the Caribbean Sea and adjacent areas. These two cases demonstrate some of the synoptic uses and limitations of the radiation data for cloud detection and surface-temperature determinations. The radiation data were found to be useful in determining areas of general cloudiness. An attempt to relate the infrared radiation measurements to surface temperature suggested a close relation between the precipitable water content and the difference between actual and effective radiation surface temperatures. Author

N64-18897 Texas A. and M. Research Foundation, College Station
INVESTIGATION OF A TIROS III PHOTOGRAPH OF THE FLORIDA PENINSULA TAKEN ON 14 JULY 1961 Scientific Report No. 6
Darryl Randerson and Aylmer H. Thompson 1 Jan. 1963 23 p refs
(Contract AF 19(604)-8450)
(AFCRL-64-237; AD-435822)

A 14 July 1961 TIROS photograph of the Florida Peninsula suggests that, by early afternoon, thunderstorm activity was concentrated along all coasts. There were indications that this peculiar distribution was related to the formation of convergence or activity lines along the coasts caused by surface heating over the interior and the development of weak sea breeze circulations along all coasts. This picture also shows the stabilizing influence of the larger lakes over the Peninsula, for example, Lake Okeechobee. Author

N64-18898 Texas A. and M. Research Foundation, College Station
AN INVESTIGATION OF TIME VARIATIONS IN A SUBTROPICAL JET STREAM AND THE ASSOCIATED CLOUD PATTERNS AS SHOWN BY TIROS I Scientific Report No. 7
Peter F. Lester, Samuel J. Hall, and Aylmer H. Thompson 1 Feb. 1964 75 p refs
(Contract AF 19(604)-8450)
(AFCRL-64-238; AD-435812)

A cloud band along the south side of the subtropical jet stream over the Gulf of Mexico was pictured by the TIROS meteorological satellite on 5 April 1960. The subsequent development of this cloud band for a 5-day period was pictured by regular TIROS observations. The TIROS data were combined with conventional surface and upper air data to obtain a more detailed analysis of the situation. The cloud band was shown to consist mainly of middle and high clouds. Cross section analysis supported the possible interrelationship of the cloud band, the so-called "jet front," and the jet stream. Support for the theory that the lifting occurs in the area of entrance on the south side of the jet stream was also found. A good fit with the jet stream model of Endlich and McLean was noted. Author

N64-18899 Texas A. and M. Research Foundation, College Station

STUDIES OF SATELLITE METEOROLOGICAL DATA FOR LOWER MIDDLE LATITUDE WEATHER SITUATIONS Final Report

Aylmer H. Thompson 1 Feb. 1964 25 p refs
(Contract AF 19(604)-8450)
(AFCRL-64-239; AD-435811)

The report summarizes studies of weather phenomena of the region near the Gulf of Mexico in which TIROS data were employed as primary information. The details of the studies have been presented in several scientific reports that are abstracted in this paper. Author

N64-18923 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

ACOUSTIC MEASUREMENTS OF WIND THROUGH A LAYER

Richard D. H. Low Mar. 1964 53 p refs
(ERDA-125; AD-435751)

A simple acoustic device for improved measurements of the mean horizontal airflow through an atmospheric layer between the surface and an elevation of 200 ft is described. It consists of a sound generator and four microphones arranged in the shape of a symmetrical tetrahedron. The wind in this layer is acoustically weighted and integrated along the path length from the surface where the microphones are located, to the top of the layer where the sound generator is placed. Results obtained with this acoustic device compare favorably with the data collected from conventional wind sensors. Author

N64-18999 Texas A. and M. Research Foundation, College Station

RADAR STUDY OF SUBTROPICAL PRECIPITATION Final Report

Vance E. Moyer 31 Dec. 1963 10 p refs
(NSF Grant 13834)
(Sci. Rept. 63-35F)

The physical morphology of subtropical precipitation was investigated. The principal mode of approach was through the use of simultaneous observations from two operational weather radars of contrasting wavelengths combined into a single dual-frequency system. An attempt was made to utilize a dual frequency system consisting of a standard U.S. Air Force AN/CPS-9 3.2-cm weather radar and a modified version of the U.S. Navy AN/APS-2F 10-cm radar. Simultaneous observations were made for the first time on 14 June 1961. However, when Hurricane Carla passed 65 miles west of the radar site on 11–12 September 1961, no usable observations could be obtained from the 10-cm radar, and those from the 3.2-cm set were so highly attenuated by the intervening heavy precipitation that clear and useful echoes of the eye of the storm could not be obtained. A 3.2–10.3-cm system was then constructed. Although this system is in operation and data are being recorded, these observations do not provide information of sufficient refinement for the morphological study. R.T.K.

N64-19012 Texas A. and M. Research Foundation, College Station

THEORETICAL INVESTIGATION OF THE APPLICABILITY OF A DUAL-FREQUENCY RADAR SYSTEM TO THE STUDY OF CONVECTIVE LIQUID PRECIPITATION

V. M. H. Von (M. S. Thesis), R. A. Clark, J. J. Stephens, and V. E. Moyer 1 Sep. 1963 101 p refs
(NSF Grant 13834)
(Sci. Rept. 63-22T)

Two radars of 10.3-cm (WSR/TAM-1) and 3.2-cm (AN/CPS-9) wavelength have been combined to form a dual-frequency system. The applicability of this system to the study of convective liquid precipitation is investigated. The radar equation is derived with particular regard to the study of precipitation and the incorporation of the rigorous Mie solution of the back-scattering cross section, σ. A brief review of drop-size distributions is given; the Marshall and Palmer distribution is used to characterize the array of scatterers in precipitation volumes. Analysis reveals that the unattenuated power received by the CPS-9 is a linear function of the power received by the TAM-1. The advantage of the attenuation-free capabilities of the TAM-1 over the CPS-9 suggests a suitable means for predicting unique values of the parametric variables. A method for determining these parameters is given. Author

N64-19013 Texas A. and M. Research Foundation, College Station

AN INVESTIGATION OF PRECIPITATION ATTENUATION AND ITS APPLICATION IN A DUAL-FREQUENCY RADAR MORPHOLOGY OF SUBTROPICAL PRECIPITATION

D. R. Greene (M.S. Thesis), R. A. Clark, J. J. Stephens, and V. E. Moyer 15 Dec. 1963 123 p refs
(NSF Grant 13834)
(Sci. Rept. 63-30T)

An indication of the magnitude of precipitation attenuation may be obtained by observation of a single, convective, precipitation echo with a dual-frequency radar system. The applicability of this attenuation in the study of convective liquid precipitation is investigated. The attenuation factor, k, is calculated by use of the rigorous Mie solution for the total attenuation cross section and the Marshall and Palmer drop-size distribution. The attenuation factor is related to rainfall rate, R, and liquid-water content, M, to obtain k-R and k-M relationships. Analysis reveals that the in-cloud vertical velocity field must be known in order to relate the attenuation factor to rainfall rate. The problem of forward scattering by both solid and liquid precipitation is examined. For small, liquid-water drops, the amount of forward scattered energy is insignificant; however, for large ice particles, forward scattering becomes important. Author

N64-19014 Texas A. and M. Research Foundation, College Station

KINEMATICAL RELATIONS AMONG RADAR-OBSERVED WATER CONCENTRATIONS, VERTICAL MOTIONS, AND LIQUID-WATER DROP-SIZE SPECTRA IN CONVECTIVE CLOUDS

R. C. Runnels (M.S. Thesis), R. A. Clark, and V. E. Moyer 31 Dec. 1963 77 p refs
(NSF Grant 13834)
(Sci. Rept. 63-31T)

A simple convection cell represents convective cloud motions for analysis using radar-measured parameters. The relationships existing between the atmospheric fields of the wind and liquid-water concentration are determined by considering a one-dimensional (vertical) continuity equation for water substance. Atmospheric values of parameters in the continuity equation are determined from radar reflectivity measurements. Empirical equations relating a particular parameter to radar reflectivities are used. The generation term accounting for water phase change in the continuity equation is significant for the center of a convective cloud. A linear variation of the generation term with height is shown. Generation decreases with increasing height. Dropsize distributions inferred from median volume drop diameters give greater

liquid-water concentrations than concentrations determined from radar reflectivity data. The mean vertical speeds of convective clouds can be determined to some extent from cloud parameters measured by a weather radar. Author

N64-19080 Weather Bureau, Washington, D.C.
FIELD OPERATIONS OF THE NATIONAL SEVERE STORMS PROJECT IN SPRING 1963
J. T. Lee, L. D. Sanders, and D. T. Williams Jan. 1964 73 p refs
(NSSP-20)

The facilities employed in the operations were: the staging area in the environs of Oklahoma City, radar, an upper-air network, a sferics network, a phototheodolite system, surface networks, a special severe weather reporting network, and aircraft. The data gathered, their form, and availability are listed. These data were gathered by radar, special and serial rawinsonde, the sferics and surface networks, and aircraft. Also, information concerning TIROS satellite photography is presented. I.v.L.

N64-19093 Advisory Group for Aeronautical Research and Development, Paris (France)
A STUDY OF ATMOSPHERIC TURBULENCE AT VERY LOW ALTITUDE [ETUDE DE LA TURBULENCE ATMOSPHERIQUE A TRES BASSE ALTITUDE]
J. Perrochon Apr. 1963 47 p in FRENCH; ENGLISH summary
(AGARD-440)

Discussed are the effects of low-altitude atmospheric turbulence on the structure and equipment of high-speed fighter aircraft under prolonged flight conditions. The approach is statistical, and research so far has been concerned with establishing acceptable standards of measuring wind characteristics. G.D.B.

N64-19189 General Mills, Inc., Minneapolis, Minn.
TROPICAL UPPER AIR STUDIES Interim Progress Report No. 3, 1 Jan.–31 Mar. 1963
A. D. Belmont and D. G. Dartt 1 Apr. 1963 19 p refs
(Contract DA-36-039-SC-89211)
(GMI-2383; AD-412545)

Three additional time sections of the monthly mean upper-air winds have been prepared for Leopoldville, Eniwetok, and Johnston Island. These graphs confirm the irregularity of the observed zonal wind directions in the tropical stratosphere, and show the complex relationship of the stratospheric to high tropospheric westerlies. Author

N64-19297 Texas A. and M. Research Foundation, College Station
THE FEASIBILITY OF A DUAL-FREQUENCY RADAR SYSTEM IN STUDYING THE MORPHOLOGY OF SUBTROPICAL PRECIPITATION
R. A. Clark (Ph.D. Thesis–Texas A. and M. U.) and V. E. Moyer 31 Dec. 1963 137 p refs
(NSF Grant 13834)

Discussed is the feasibility of a dual-frequency radar system to study the morphology of subtropical precipitation. To verify theoretical feasibility, 3.2 cm (AN/CPS-9) and 10.3 cm (WSR/TAM-1) radars were used. Various techniques were examined for determination of in-cloud liquid-water content. An estimate of water content can be made if the drop-size distribution can be characterized realistically by a 2-parameter distribution function. Attenuation coefficients for 3.2-cm radiation are determined from data from the dual-frequency system and are employed in a technique for estimating the drop-size distribution. Empirical relationships between radar reflectivity and liquid-water content using data from a single radar also are examined. The computed in-cloud liquid-water fields appear realistic. Fields of vertical motion are computed by use of the continuity equation for liquid-water concentration. These yield volume-integrated values, which appear realistic for the type of radar echoes examined. Author

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-18693 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AUTOMATION IN COSMIC NAVIGATION
A. M. Letov 26 Jul. 1963 6 p Transl. into ENGLISH from Nauka i Zhizn, (Moscow), no. 11, 1962 p 28–29
(FTD-TT-63-608/1; AD-413983)

The automatic devices used to solve the complex problems of space flight are discussed. These devices are used for a variety of problems, ranging from controlling the spaceship and its internal environment to the organization of continuous radio communication with the earth. R.T.K.

N64-18718 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
"KOLLARM", A NEW COLLISION WARNING DEVICE ["KOLLARM", EIN NEUES KOLLISIONSWARNGERAT]
H. Matusche London, Min. of Aviation, Dec. 1963 32 p Transl. into ENGLISH from Luftfahrttechnik Raumfahrttechnik 9 (1963) 2, p 54–63
(RAE-TRANS-1053)

This collision warning device makes it possible to know, in an observing aircraft, whether its course and that of an observed aircraft form a collision triangle, and, in that event, gives an alarm signal. The method adopted, and denoted as "Kollarm," makes use of electromagnetic waves; all participating aircraft are fitted with a transceiver and rotating directional antennas. To each receiver, a visual indicator is connected whereby the relative bearings of individual aircraft in the effective range, together with the relative velocity in the direction of the foreseeable minimum separation distance, can be read off; the intensity of the received signals also allows the instantaneous distances to observed aircraft, and the times remaining up to collision, to be estimated. Author

N64-19193 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE GUIDING OF AIRCRAFT UNDER RADAR-JAMMING CONDITIONS
Z. Guminski 19 Feb. 1963 24 p Transl. into ENGLISH from Naprowadzanie Samolotov w Warunkach Zaktocen Radiolokacyjnych (Warsaw), no. 6, 1962 p 20–30
(FTD-TT-62-1879/1+2; AD-298224)

After an introductory description of passive and active radar-jamming methods, purposes, and results, the techniques of detecting the attacking aircraft through the interference are discussed. Methods of guiding fighter aircraft to airborne targets under radar-jamming conditions are explained. R.L.K.

N64-19280 National Aeronautical Establishment, Ottawa (Canada)
A MODEL-CONTROLLED AUTOPILOT FOR AN AIRBORNE VTOL SIMULATOR
D. F. Daw and L. V. Ursel Natl. Res. Council of Canada, Feb. 1961 38 p refs
(LR-302)

To establish handling qualities for VTOL and STOL aircraft, a simulator which adequately simulates the dynamic response and environment of the vehicle is needed. A variable stability helicopter is proposed to meet this need. A model-controlled autopilot may be used to vary the characteristics of a helicopter, enabling simulation of aircraft having a wide variety of dynamic response characteristics. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-18525 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MOVEMENT OF A GAS UNDER THE ACTION OF A CONCENTRATED IMPACT ON ITS SURFACE (DURING AN EXPOLSION ON THE SURFACE)
Yu. P. Rayzer 24 Sep. 1963 23 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 1, Jan.–Feb. 1963 p 57–66
(FTD-MT-63-80/1+2+3+4; AD-434954)

Considered is the motion of a gas, originally in surface contact with a vacuum, that is affected by concentrated and scattered impacts on the surface or by localized and scattered explosions on the surface. The problem of concentrated impact serves as an idealized model. It describes the initial stage of shock-wave propagation caused by a meteorite falling with great speed on the surface of a planet deprived of atmosphere, or by the impact of a micrometeorite against the surface of an artificial satellite. It is a two-dimensional analog of a problem concerning transient impact on a plane. The qualitative picture of motion is described, and the total limitation on the index of automodelness (sic), n, in the law of attenuation of a shock wave, $p \sim M^{-n}$ (p = pressure, M = mass), enveloped by the shock wave, is established. Author

N64-18548 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DIGITAL SHOCK SPECTRUM ANALYSIS BY RECURSIVE FILTERING
D. W. Lane *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 173–181 refs (See N64-18534 11-33)

This article is concerned with recursive filtering, a feedback technique employed as an efficient method of digital-shock-spectrum analysis. By this method, each output point is calculated as a linear combination of one set of weights with the input points, along with a linear combination of another set of weights with previous output points. The accuracy, flexibility, and production capability of the digital computer are thus made available without the sacrifice of excessive computer time. The techniques utilized in the method are outlined, the virtues and limitations of digital-shock-spectrum analysis are discussed, and applications are suggested that appear to be useful in the shock and vibration area. C.L.W.

N64-18549 Aeronautical Systems Div., Wright-Patterson AFB, Ohio
AN ANALOG COMPUTER TECHNIQUE FOR OBTAINING SHOCK SPECTRA
J. J. Marous and E. H. Schell *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 182–194 refs (See N64-18534 11-33)

A unique method of computing the shock spectra of transient motions on an analog computer has been developed. The uniqueness of the method is largely due to controlling the output voltages in such a manner that a direct graphical plot of the shock spectrum is recorded on a strip-chart recorder. Another feature is the use of punched tape programing for making automatic frequency and gain changes. Author

N64-18550 Sandia Corp., Albuquerque, N. Mex.
THE USE OF GRAPHICAL TECHNIQUES TO ANALYZE SHOCK MOTIONS OF LIGHTLY DAMPED LINEAR SPRING MASS SYSTEMS
R. O. Brooks *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 195–210 refs (See N64-18534 11-33)

Results are presented of an investigation conducted to ascertain if the phase-plane method could be extended to find acceleration or displacement responses of general multidegree damped systems that are most likely to be encountered in mechanical-shock testing. The investigation indicated that responses of three types of single-degree systems—undamped, coulomb damped and viscously, damped—could be solved by graphical methods. Three models were subjected to shock pulses. The monitored response histories were then compared to the phase-plane constructed response histories. The shape of the measured response histories closely resembled the calculated response histories, but were somewhat larger in amplitude than theoretically possible for linear systems. The differences are attributed to nonlinearity of the springs. C.L.W.

N64-18551 California U., Livermore Lawrence Radiation Lab.
SHOCK SPECTRA FOR A GENERAL FORCING FUNCTION
A. F. Todaro *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 211–215 refs (See N64-18534 11-33)
(Supported by AEC)

Shock spectra, which are the maximum responses of many one-degree-of-freedom systems to a particular shock force or motion, can be helpful in the understanding of the general motion of elastic bodies subjected to shock forces or motions. Although shock spectra for well-defined analytic functions are available, those for nonanalytic forcing functions are not so easily found. A method for determining these spectra is described. Author

N64-18552 McDonnell Aircraft Corp., St. Louis, Mo.
SOLUTION OF STRUCTURAL RESPONSE PROBLEMS BY ANALOG COMPUTERS
R. Pittman and R. W. Wheeler *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 215–229 (See N64-18534 11-33)

A demonstration is given of the use of analog computers in the analysis of dynamic response of aircraft structures to continuous random and impulsive exciting phenomena. It is shown how computers were used in the solution of two

separate and entirely different problems. The first problem discussed is the fuselage-response study of a high-performance reconnaissance aircraft subjected to random atmospheric turbulence. The operational analog computer was chosen for this problem because of the inclusion of a nonlinear control system, and because mode shapes were previously available. The second problem, the dynamic response of a low-aspect-ratio aircraft wing to a carrier landing, was solved on the direct analog computer. C.L.W.

N64-18560 Ling-Temco-Vought, Inc., Dallas, Tex. Aeronautics Div.

RANDOMNESS TESTER FOR ACOUSTIC SIGNALS

E. D. Griffith *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 291–295 refs (See N64-18534 11-33)

Measurements were made of the deviations of the number of zero crossings per second in band-limited random noise as caused by the addition of periodic signals to this noise. These measurements were made, on selected frequency bandwidths, of the unknown acoustic-noise signal. Indications of hidden periodicities were obtained for the frequency band below a frequency designated $F_D{}^{11}$ on a power spectral-density curve. These indications included some deviations in the number of zero crossings per second up to 15%. Measurements on the band above $F_D{}^{11}$ showed zero or very small deviations in the number of zero crossings per second. C.L.W.

N64-18571 Army Materials Research Agency, Watertown, Mass. Materials Research Lab.

MEASUREMENT OF THE ATOMIC SCATTERING FACTOR OF NE, AR, KR, AND XE

David R. Chipman and Laurence D. Jennings, Jr. Sep. 1963 19 p refs

(AMRA-TR-63-15; MRL-135; AD-421711)

To test the accuracy of the Hartree–Fock (HF) method and the reliability of X-ray measurements of the atomic scattering factor f, the scattering of MoKα radiation by Ne, Ar, Kr, and Xe gases has been determined. Values of f were obtained on an absolute basis with an accuracy of about 1/4%. Results at small angle yield the mean-square radius of the electron cloud $\langle r^2 \rangle_{av}$ and the dispersion correction. For Ne, Ar, and Kr, the values of $\langle r^2 \rangle_{av}$ are in good agreement with HF calculations. For Xe, the experimental value is significantly lower. Susceptibility results yield about 6% lower values in each case. Derived values of the dispersion correction are each more negative than those obtained from published absorption coefficients. At higher angles, the f values differ by less than 0.2 electron units from the HF values for all the gases; even for Xe, the approximate HF values presently available are more nearly accurate than the TFD values. Author

N64-18572 Army Materials Research Agency, Watertown, Mass.

THE SPIN DENSITY IN COBALT

R. J. Weiss Sep. 1963 7 p refs

(AMRA-TR-63-18; MRL-136; AD-422958)

An alternate interpretation is given to the polarized neutron diffraction data of Menzinger and Paoletti on fcc cobalt. Several objections are given to their interpretation of a large difference in the mean-square amplitude of thermal vibration of the spin density compared to the nucleus. The data are alternately interpreted on the basis of a temperature dependence of the radial distribution of spin density with total radial charge density unchanged. The relative occupations of e_g and t_{2g} orbitals for fcc cobalt are also derived from the data. Author

N64-18573 Army Materials Research Agency, Watertown, Mass.

ON THE SIGN OF THE EXCHANGE INTEGRAL IN TRANSITION METALS

R. J. Weiss Dec. 1963 10 p refs

(AMRA-TR-63-29; MRL-141; AD-428309)

A qualitative picture of the electronic structure of ferromagnetic and antiferromagnetic metals and alloys is given. Ferromagnetism occurs when half the 3d states are completely filled (the other half only partially), and antiferromagnetism occurs when neither half of the 3d states is completely filled. Gamma iron appears to be an example of a metal that can exist in both forms. Author

N64-18574 Indiana General Corp., Valparaiso Magnetic Research Lab.

A MODIFIED SANFORD-BENNETT HIGH-H PERMEAMETER Final Report

R. K. Tenzer Wright-Patterson AFB, Ohio. Aeron. Sys. Div., May 1963 11 p refs

(Contract AF 33(657)-8499)

(ASD-TDR-63-421; AD-420237)

The Sanford-Bennett High-H permeameter was developed originally for measuring hysteresis loops on Alnico magnets. It permits a magnetizing force (H) of 5,000 oersted (Oe) in a 5-cm gap. Narrowing the gap is limited to 2.1 cm by the flip coil arrangement, which limits the magnetizing force to about 8,000 Oe. In order to extend this limit, the permeameter had to be modified. The flip coils were replaced by a Hall probe to measure H and "compensated coils" were used to measure intrinsic induction (B-H). The minimum gap could thus be reduced to 0.65 cm and the magnetizing force increased to about 11,000 Oe. The use of tapered 40%-Co 60%-Fe Pole pieces and applying 200v made it possible to double this value. Author

N64-18585 Johannes Gutenberg- Universität, Mainz (W. Germany) Meteorologisch-Geophysikalisches Inst.

RESEARCH ON ATMOSPHERIC OPTICAL RADIATION TRANSMISSION Scientific Report No. 2

E. de Bary, K. Bullrich, R. Eiden, and W. Nowak 31 Jan. 1964 124 p refs

(Contract AF 61(052)-595)

(AFCRL-64-126; AD-434773)

The following are discussed: (1) the influence of the aerosol-size distribution on the degree of polarization of the diffuse sky radiation; (2) the influence of the multiple scattering and reflection on the spectral distribution of the sky radiation; (3) a first attempt at comparing the measured values of the intensity of the diffuse sky radiation and its degree of polarization with theoretical values obtained by way of approximation, taking into account the effect of multiple scattering; (4) the influence of the multiple scattering on the intensity and polarization of the diffuse sky radiation; (5) programing Mie's scattering functions for absorbing particles; and (6) progress in instrumentation. R.T.K.

N64-18623 California U., Berkeley Inst. of Engineering Research

ON THE MOLECULAR INTERACTIONS BETWEEN GASES AND SOLIDS

F. C. Hurlbut 15 Nov. 1962 36 p refs Presented at the AFOSR-GE Symp. on the Dynamics of Manned Lifting Planetary Entry, Philadelphia, Oct. 1962 Submitted for Publication

(Contract Nonr-222(45))

(HE-150-208; AD-295409)

Problems of energy and momentum transfer between the gas particle and the surface are examined with attention given to those processes that directly influence the flow under free-molecule and near-free-molecule conditions. A review of both early and very recent scattering studies reveals consistent trends in the reflected angular distribution in particle flux from cleaved and degassed alkali halide crystals and from certain degassed metal surfaces. These observations lend support to a dynamical model of the lattice in interaction with the gas particle. In connection with this model three broad regimes of interaction in the presence of attractive forces are defined. Author

N64-18624 General Dynamics/Astronautics, San Diego, Calif.
CALCULATION OF CROSS SECTIONS FOR THE VIBRATIONAL EXCITATION OF CO_2 BY COLLISION WITH N_2
R. Marriott Feb. 1964 22 p refs
(Contract AF 19(628)-3269; ARPA Order 363; Proj. Defender)
(GDA-DBE-64-004; AD-434016)

The results of a calculation of cross sections for the vibrational excitation of CO_2 by collision with N_2 for energies in the range 0 to 4 ev are presented. The method of calculation is described and, in order to indicate the nature of the approximations made in this approach, the analysis is included. Discussions of general collision theory, the intermolecular potential function, and solution of the scattering equations are presented, and the assumptions made for calculation purposes are given. E.W.

N64-18625 Brown U., Providence, R.I. Div. of Applied Mathematics
MULTIPOLAR CONTINUUM MECHANICS
A. E. Green and Ronald S. Rivlin Mar. 1964 96 p refs
(Contract Nonr-562(10))
(C11-88; AD-434679)

A general theory of multipolar displacement and velocity fields with corresponding multipolar body and surface forces and multipolar stresses is developed by using an energy principle, an entropy production inequality, and invariance conditions under superposed rigid-body motions. Constitutive equations for the multipolar stresses are discussed, and explicit results are given for an elastic medium. Author

N64-18630 Uppsala U. (Sweden)
MAGNETIC FIELD VARIATIONS IN VICINITY OF LIGHTNING DISCHARGES Final Scientific Report, 1 Oct. 1958-30 Jun. 1963
Harald Norinder [1963] 23 p refs
(Contract AF 61(052)-171)
(AFCRL-64-78; AD-434772)

The topics discussed include: (1) frequency analysis of the magnetic-field variations in lightning discharges; (2) lightning paths in relation to the magnetic-field variations emitted from them—investigations of the magnetic-field strength variations of lightning discharges in the vicinity regions of lightning paths; (3) multiple lightning discharges; (4) the statistical distribution of lightning paths as determined from cathode-ray oscillographs at field stations; (5) a theoretical analysis of the mechanism of lightning discharges; (6) the calculation of lightning surges induced in electric transmission lines; and (7) the theory of multiple lightning strokes. R.T.K.

N64-18633 Harvard Coll. Observatory, Cambridge, Mass.
GENERALIZED TABLES FOR THE CALCULATION OF DIPOLE TRANSITION PROBABILITIES IN LS-COUPLING
Bruce W. Shore and Donald H. Menzel Feb. 1964 63 p refs
(Contract AF 19(604)-4962)
(Sci. Rept. 29; AFCRL-64-37; AD-434151)

Calculation of transition probabilities or oscillator strengths for allowed transitions proceeds in two steps: calculation of the dipole-moment matrix in a simple coupling scheme (usually LS-coupling), followed by transformation of this matrix to the energy scheme. Though the oscillator strength for any transition is proportional to the square of a matrix element, the transformation step requires absolute values, including signs (±). Existing tables of line and multiplet strengths omit these signs, and hence are useful only when the atomic states are nearly LS-coupling states—often a poor approximation. Application of the algebra of tensor operators developed by Racah breaks the matrix-elements into a Line Factor, a Multiplet Factor, and a Transition Integral. A collection is presented of formulas and tables that permit the calculation of transitions of the types l^l-$l^{l'}$; lsp-ls^2: $p^n - p^{n-1}l$; $p^ns - p^{n-1}sl$; $p^ns - p^{n-1}sl, p^ns - p^{n-1}ls$; $p^ns - p^{n-1}s^2$: $d^n - d^{n-1}l$; $d^ns - d^{n-1}sl$; and $d^ns - d^{n-1}l$'s. Author

N64-18641 General Electric Co., King of Prussia, Pa. Space Sciences Lab.
THEORETICAL HYPERVELOCITY IMPACT CALCULATIONS USING THE PICWICK CODE Interim Report, 24 Jun.-23 Dec. 1963
T. D. Riney Mar. 1964 83 p refs
(Contract AF 08(635)-3781)
(ATL-TDR-64-8; AD-434220)

The principal uncertainty in the viscoplastic model of hypervelocity impact is the lack of data on strain-rate effects under the severe conditions of interest. Estimates of μ for iron and aluminum are determined that are compatible with both observed strain-rate effects in plastic waves and the very abrupt shock profiles known to exist at pressures greater than about 0.2 megabar. Detailed calculations are presented describing the cratering process for a cylindrical projectile impacting a thick target of like metal. It is shown that momentum scaling cannot be justified. The depth of penetration is related to impact velocity v_o according to $P_c = K_e v_o$ 2/3 for $v_o \geq v_o^*$. Strength effects of the target do not vanish with increasing impact velocity. The cratering and the penetration process for thin plates is studied. PICWICK calculations are presented, and the results are discussed in terms of the interactions of shock waves, rarefaction waves, and configuration geometry. Author

N64-18649 Northrop Corp., Hawthorne, Calif. Space Labs.
COMPUTER ANALYSIS OF RADIATION SHIELDING Final Report
R. E. Fortney Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., Feb. 1964 98 p refs
(Contract AF 33(657)-8762)
(NSL-63-168; AMRL-TDR-64-11; AD-435737) OTS: $2.25

The purpose of this mathematical study was to develop mathematical methods to assess the biological hazards of space radiation and to program these methods for the IBM 7090 using FORTRAN language. A semianalytical approach was utilized to write machine programs for geocentric trajectories; and for a model astronaut inside a space vehicle. The trajectory program is used to solve the two-body problem with perturbations to correct for the oblateness of the earth. The earth's magnetosphere is the space of principal interest for lunar missions; therefore lunar impact and return trajectories are considered to be two-body geocentric orbits. An astronaut's head and torso are represented by two right elliptical cylinders. This model is placed inside a mathematically described space vehicle with known thicknesses in designated areas. An existent

machine program was utilized to define the radiative environment in McIlwain (B,L) coordinates, and supplemental computer programs were used to determine radiation doses resulting from electron and proton environments. Author

N64-18663 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

APPROXIMATE CALCULATION OF THE DISTRIBUTION OF CURRENT DURING THE FLOW OF A CONDUCTING LIQUID THROUGH A CHANNEL IN A MAGNETIC FIELD

A. B. Vatazhin and S. A. Regirer 17 Dec. 1963 20 p refs Transl. into ENGLISH from Prik. Mat. i Mekh. (Moscow), v. 26, no. 3, 1962 p 548–556
(FTD-MT-63-8; AD-434952)

This paper deals with certain questions related to the calculation of the spatial distribution of the electric current in a conducting medium moving through a channel in the presence of a magnetic field. The necessity of formulating three-dimensional problems arose as a result of the impossibility of studying within the framework of one-dimensional theory such phenomena as the entry of an electrically conducting medium into a magnetic field and the effect of inhomogeneity of the boundary conditions on the perimeter of the cross section and along the channel. The problem of the distribution of current during the flow of an electrically conducting medium in channels is considered in a general formulation, and the assumptions leading to simplified solutions are indicated. Author

N64-18675 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

HIGH-VOLTAGE PULSE MODE OF IONIC SOURCE PENNING

A. V. Chernetskiy 17 Jul. 1963 15 p refs Transl. into ENGLISH from Russian book, "Nekotoryye Vopr. Tekh. Fiz. Eksperimenta Pri Issled. Gaz. Rasryada," Moscow, Gosatomizdat, 1961, no. 3, p 105–113
(FTD-MT-63-65/1+2; AD-434960)

Components of this ionic source include: a three-electrode molybdenum glass Penning tube with an anode, in the form of a wire ring, and with two flat cathodes; (the three electrodes refer to a stretching electrode, a focusing electrode, and an accelerating electrode); a Faraday cylinder; and a magnetic coil. When this ionic source is fed with high-voltage pulses, the following advantages are evidenced: (1) The high energies of the electrons, due to their oscillations and difficult departure from the discharge, give a high degree of gas ionization, which is many times strengthened by secondary processes. (2) Regions of the most intense ionization are located near the cathodes. This creates favorable conditions for forming a beam, promotes a large cathode fall in potential in the glow discharge, and enables the creation of a large output aperture for the ions. (3) Operation at low gas pressures (10^{-4} to 10^{-5} mm Hg) is possible. (4) The Penning source can at increased pressures (10^{-3} to 10^{-2} mm Hg) compete with arc sources. (5) The source can operate with full stability for a very long period of service. (6) An ion output up to 50% can be achieved. (7) Differential exhaust is not required. I.v.L.

N64-18676 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

IN REFERENCE TO THE THEORY OF ELECTRICAL COAGULATION OF SPHERICAL AEROSOL PARTICLES

Yu. V. Shulepov and S. S. Dukhin 17 Jul. 1963 8 p refs Transl. into ENGLISH from Kolloid. Zh. (Moscow), v. 24, no. 6, 1962 p 749–751
(FTD-MT-63-70/1+2; AD-434958)

From a consideration of the elementary act of electrical coagulation of aerosol particles as a two-body problem, formulas have been derived for the capture efficiency for an arbitrary ratio of the particle radii. The known formulas for capture efficiency, derived on the basis of the elementary electrical coagulation, act as a one-body problem and are particular cases of the formulas derived in the present study. Author

N64-18677 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DIFFUSION OF SLOW NEUTRONS THROUGH LIQUID OXYGEN

S. V. Starodubtsev and B. I. Khrushchev 24 Sep. 1963 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 1, 1963 p 51–55
(FTD-MT-63-82/1+2+3+4; AD-434953)

The average energy of a neutron beam were determined in measurements conducted on liquid nitrogen and oxygen. Oxygen in a Dewar flask of cylindrical form 12.4 cm in diameter and prepared from brass and stainless steel was used for most of the tests. Diffusion samples 7.0 and 10.0 cm thick were used on input windows. The distance between the lateral walls of the flask and bellows did not exceed 3 to 5 mm. At a thickness of sample of 21.3 cm, the input windows were closed with copper foil 0.1 mm thick. The beam was collimated by round collimators 3 cm in diameter. The spectrum of neutrons of the primary beam and neutron beam diffusing through the sample was determined with the help of filters made of natural boron. Results are given in tabular form. J.E.T.

N64-18679 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ULTRASOUND

Yu. Urzhumtsev 19 Dec. 1963 11 p Transl. into ENGLISH from Nauka i Tekhn. (Riga), no. 7, 1962 p 8–10
(FTD-MT-63-129; AD-434996)

An ultrasonic method for determining the quality and durability of concrete is described. Both audible and inaudible sounds can be used for testing concrete and reinforced concrete. R.T.K.

N64-18683 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN GENERALIZATIONS AND RESULTS OF INVESTIGATING THE THEOREM OF REVERSIBILITY FOR A TRANSIENT MOTION

B. I. Ul'yanov 6 Dec. 1963 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Mekh. i Mashinostr. (Moscow), no. 1, 1961 p 70–74
(FTD-MT-63-140; AD-434992)

A generalization of the theorem of reversibility for transient motion of a body near a discontinuity surface or within a solid, liquid, or cylindrical surface is presented. Relationships are obtained that provide a method of calculating the additional aerodynamic forces and moments on a wing when they are caused by displacement of flaps or ailerons. R.T.K.

N64-18698 University Coll. of Wales, Aberystwyth (Gt. Brit.)

SPECTROSCOPIC STUDIES: PART 3, ANALYSIS OF THE ACETALDEHYDE VIBRATION-ROTATION BAND NEAR 764cm.$^{-1}$ Technical Note No. 7

J. A. Ladd and W. J. Orville-Thomas 30 Oct. 1963 14 p
(Contract AF 61(052)-691)
(AFCRL-64-218; AD-430708)

The rotational structure of the 764 cm^{-1} band of acetaldehyde has been measured. An analysis of this band has been carried out in order to correlate the observed rotational fine structure with the molecular dimensions. Author

N64-18703 Ohio State U. Research Foundation, Columbus
MAGNETORESISTANCE EFFECT IN "ADVANCE" AND "EVANOHM" WIRES AT LOW TEMPERATURES IN FIELDS UP TO 50 KILOGAUSS Technical Report No. 11
E. Lerner and J. G. Daunt Mar. 1964 9 p refs
(Contract Nonr-495(20))
(AD-434385)

Isothermal measurements of the electrical resistance of Advance and Evanohm wires were made using standard potentiometric methods. The variation of electrical resistivity ρ of the specimens in zero magnetic field with temperature, T, is given. The isothermal magnetoresistive effect, given by $\Delta\rho/\rho$ where $\Delta\rho$ is the difference between the resistivity in a magnetic field and the resistivity in zero magnetic field is given for measurements made at 4.2° K. There was no effect for the Evanohm wire. For Advance wire, the magnetoresistive effect is negative and is almost the same in both a transverse and a longitudinal field. E.W.

N64-18724 Advisory Group for Aeronautical Research and Development, Paris (France)
THOUGHTS ON THE PROBLEM OF AERODYNAMIC NOISE SOURCES NEAR SOLID BOUNDARIES
J. E. Ffowcs Williams (Natl. Phys. Lab., Gt. Brit.) Apr. 1963 36 p refs Presented at the AGARD Specialists' Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963 Summary in FRENCH
(AGARD-459)

This report deals with a development of Curle's equations governing sound radiated by surface dipoles, which establishes, directly from those equations, the reflection phenomenon first noted by Powell. The development is for a particular situation, not easily treated by Powell's result, that of a turbulent boundary layer on a rigid flat plate radiating sound to a point so distant that the surface appears small. The development takes such a form that an estimate of the plate size, above which the dipole contribution vanishes and the plate assumes its role of an acoustic reflector, is made possible. The estimate, which is essentially an approximate one, suggests that surfaces have to be very large indeed before they become good reflectors. Author

N64-18727* Sperry Microwave Electronics Co., Clearwater, Fla.
PYROELECTRIC DETECTION TECHNIQUES AND MATERIALS
Washington, NASA, Apr. 1964 44 p
(NASA Contract NASw-711)
(NASA CR-44) OTS: $1.25

Measurements are reported on $BaTiO_3$ single crystals and ceramics, doped $BaTiO_3$, $PbTiO_3$, and a sample of triglycine sulfate. Measurements reported include noise equivalent power, responsivity, and response time on various detectors at optical and near infrared radiation frequencies. Measurements of detector characteristics as a function of temperature are reported. The results of analytical investigations of pyroelectric detectors are included. The detector equivalent circuit is derived and analyzed for sinusoidal and square wave modulation of radiation. Parameters of pyroelectric materials are related to detector characteristics. Author

N64-18745 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DISTORTION OF FORM OF ULTRASONIC WAVE OF FINITE AMPLITUDE IN SOLIDS
V. A. Krasilnikov and A. A. Gedroyts 12 Apr. 1963 6 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 2, 1962 p 92–93
(FTD-MT-63-13/1+2+3+4; AD-434951)

The distortion of the form of ultrasonic waves of finite amplitude in solids was investigated. It is shown that, besides the nonlinearity of the equation of motion, an essential role is played by the nonlinearity of the equation of state. However, for certain solids (for example, plexiglas and certain kinds of glass) the ratio $\alpha_{exp}/\alpha_{theor.}$, where α is the amplitude of the pressure of the second harmonic, is, conversely, less than one. This can signify the presence of a reverse sign of the effect of the influence of the equation of state. The second harmonic can be clearly observed (for example, for a single aluminum crystal) at 10 to 20 volts on radiating quartz. It is possible to observe the third and higher harmonics (for example, in polystyrene). On transverse waves, distortions of the ultrasonic waves were not observed. I.v.L.

N64-18756 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING ELASTIC SCATTERING OF PROTONS OF LARGE ENERGIES
G. G. Arushanov 17 Jul. 1963 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 5, 1962 p 87–88
(FTD-MT-63-53/1+2; AD-434964)

An attempt to roughly estimate a section of elastic scattering of high energy protons (>1 Bev), stipulated by two-meson exchange, is discussed. It is assumed that the main role in this exchange is played by the excited state of two π-mesons with unit spin. The case of the elastic scattering of proton to proton is considered. I.v.L.

N64-18760 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BEHAVIOR OF A SECOND ORDER DYNAMIC SYSTEM WITHOUT DAMPING UNDER THE INFLUENCE OF RANDOM PROCESSES
A. A. Sveshnikov 24 Jul. 1963 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Energ i Avtom. (Moscow), no. 5, 1962 p 96–98
(FTD-MT-63-75/1+2; AD-434957)

The behavior of a second-order dynamic system, without damping, under the influence of random processes was investigated. Results of calculations show that when a linear member of the second order does not have damping, entrance to the input of the link of a continuous random process leads to the growth of output-process dispersion according to a linear law. Miscalculation of this phenomenon can lead to serious errors (for example, in the appraisal of the accuracy of inertial navigation systems). I.v.L.

N64-18762 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING RESONANCE IN AN ESSENTIALLY NONLINEAR SYSTEM
F. L. Chernous'ko 14 Nov. 1963 29 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 3, no. 1, 1963 p 131–144
(FTD-MT-63-112; AD-434998)

An essentially nonlinear system, which is nearly an integrating Hamiltonian and which includes both oscillatory and rotary motions, is considered by the method of averaging resonance. Using this technique, stationary resonance conditions may be found for the system, and their stability may be investigated. As an example, the method is applied to the resonance nonlinear oscillatory and rotary motions of a pendulum. E.W.

N64-18766 Emmanuel Coll., Boston, Mass. Research Language Center
DETERMINATION OF THE OPTICAL CONSTANTS OF METALS [BESTIMMUNG DER OPTISCHEN CONSTANTEN DER METALLE]
P. Drude Bedford, Mass., AFCRL [Mar. 1963] 99 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 39, 1890 p 481–554
(Contract AF 19(604)-8505)
(E-T-G-63-1; AD-430983)

The following are discussed: (1) different methods for determining the optical constants of metals; (2) the effects of surface layers; (3) a method for obtaining the normal state of a metal mirror; (4) a favorable observational arrangement of a metal mirror for determining most accurately the optical constants of a metal; (5) observations—the constants of metals for sodium, the dispersion of metals, the relationship between optical constants and temperature, and observations of metal reflection in different fluids; (6) a comparison between present and past observations; and (7) a test of Kundt's law and the electromagnetic theory of light. R.T.K.

N64-18771 New Mexico U., Albuquerque Engineering Experiment Station
REFLECTION AND REFRACTION IN A NON-TURBULENT ATMOSPHERE WITH MOVING INTERFACES
Donald C. Thorn and James E. Leeman Jan. 1964 16 p ref
(Contract AF 29(600)-3445)
(EE-101; AD-435985)

The purpose of this report is to supply a basis for engineering design in high-precision laser radar systems. It is demonstrated that, for a moving interface, the angle of reflection is not equal to the angle of incidence, and that Snell's Law does not apply (in its usual form) to the angle of transmission. In addition, relations are developed that appear to be useful and convenient for a practical calculation of the appropriate angle. Also, it is demonstrated that the usual Doppler-shift expression must be modified to account for the angular deviation. Because of the angular and frequency modifications, it appears that a corner reflector will not produce precisely the same results as a properly orientated flat reflector. However, this difference in results is not computed. I.v.L.

N64-18780 Ohio State U. Research Foundation, Columbus
RESISTANCE MINIMUM IN EVANOHM WIRE Technical Report No. 12
R. C. Pandorf, E. Lerner, and J. G. Daunt Mar. 1964 5 p refs
(Contract Nonr-495(20))
(AD-434386)

The electrical resistivity of Evanohm wire (75% Ni, 20% Cr, 2.5% Al, 2.5% Cu) in a zero magnetic field was measured at temperatures down to 0.3° K. The data below 4.2° K are illustrated by plotting ρ/ρ_{293} vs T. It is evident that Evanohm passes through a resistance minimum. The temperature of this minimum can be estimated to be approximately 15° to 20° K. The observed temperature coefficient of resistance at about 0.5° K is $-0.003°\ K^{-1}$. The existence of this negative temperature coefficient of resistance below 1° K may be of value for thermometry. I.v.L.

N64-18797 Atomic Energy Commission, Washington, D.C. Technical Information Div.
SECOND ANNUAL OAK RIDGE RADIOISOTOPE CONFERENCE APRIL 19-22, 1964
1964 149 p refs
(Sponsored by Oak Ridge Inst. of Nucl. Studies)
(TID-7689) OTS: $2.50

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32. A UNIQUE SCINTILLATOR FOR NEUTRON DETECTION H. H. Ross (ONRL) p 103–105
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N64-18798* United Nuclear Corp., White Plains, N.Y. Development Div.

USING GAMMA TRANSMISSION TO DETERMINE THE SHIELDING EFFECTIVENESS OF SPACE VEHICLES

A. D. Krumbein and P. S. Mittelman *In* AEC, Washington, D.C. Second Ann. Oak Ridge Radioisotope Conf., 19–22 Apr. 1964 1964 p 76–80 (See N64-18797 11-23)

(NASA Contract NAS8-5252)

OTS: $2.50

In an attempt to obtain a precise evaluation of shielding effectiveness of spacecraft, a gamma-ray technique, which measures areal electron densities along paths through material structures and equipment, was developed. The method is based on measurements of the attenuation of gamma-rays through the samples to be evaluated. It was found that, in addition to being able to determine dose fairly accurately in uncollimated geometry, the spatial details of heterogeneous structures could also be delineated without the use of collimation. P.V.E.

N64-18799 Halliburton Co., Duncan, Okla.

HOW TO OBTAIN MORE FRACTURING INFORMATION BY THE USE OF RADIOISOTOPES

R. George Mihram *In* AEC, Washington, D.C. Second Ann. Oak Ridge Radioisotope Conf., 19–22 Apr. 1964 1964 p 105–118 refs (see N64-18797 11-23)

OTS: $2.50

It is shown how radioisotopes (radioactive sand, in particular) can be used to obtain information on fracturing in oil wells and how this information can be applied to the solution of fracturing problems. Some of the more recent advances and concepts in the use of radioactive materials, and interpretations of the results obtained are presented. Radioactive sand-filled fractures are located by logging with a gamma logging tool. Through the use of radioactive sand, definite evidence can be obtained with respect to the following conditions: (1) location of either horizontal or vertical fractures with respect to depth, (2) type of fracture produced, (3) number of fractures produced, (4) thickness of fractures at the well bore, (5) vertical extent of vertical fractures, and (6) the effect of overflush on the fracture. P.V.E.

N64-18859 California U., Berkeley

THEORY OF FAST REACTIONS

M. Boudart, A. K. Oppenheim, and R. W. Getzinger *In* Va. U. Project Squid 1 Apr. 1964 p 35–36 ref (See N64-18851 11-24)

(Contract Nonr-3623(S-11))

The following velocities of detonation, for a mixture containing 92.3% ozone and 7.7% oxygen at an initial pressure of 160 torr, were measured in m/sec of 1,700, 1,774, 1,786, and 1,801 in tubes of internal diameter equal to 1.00, 6.35, 12.7, and 25.4 mm, respectively. The theoretical value is calculated to be 1,838 m/sec; thus the velocity deficit is very small. This absence of a marked velocity deficit for detonation waves in ozone leads to the conclusion that if vibrationally excited molecules of oxygen are produced in the waves, they have sufficient time to relax and reach thermodynamic equilibrium. I.v.L.

N64-18863 Virginia U., Charlottesville

INELASTIC MOLECULAR COLLISIONS

John E. Scott, Jr., Jesse H. Heald, John F. Moonan, Harold S. Morton, Jr., and John A. Phipps *In its* Project Squid 1 Apr. 1964 p 59–62 refs (See N64-18851 11-24)

Emphasis was given to the experimental determination of molecular velocities in aerodynamic molecular beams. It was found that the beam distribution function is independent of nozzle-skimmer separation distance above a critical value, which is a function of nozzle-source density, and the distribution function determined experimentally cannot be fitted to a Maxwellian distribution function. The corrections to be applied to the equilibrium (Maxwellian) distribution function to account for the finite macroscopic property gradients in the skimmer flow field have been estimated. Also, calculations have been initiated to explore the nature of the flow that can be expected to occur when the mean free path of the source gas is of the same order as the source diameter. In this case, molecules that emerge from the source are likely to have suffered a collision in the vicinity of the source orifice, where the gradients in density, streaming velocity, and the mean random kinetic energy, i.e., "temperature," are relatively steep. Such collisions can be expected to give rise to a flow pattern that is significantly different from that observed in the collisionless limit. I.v.L.

N64-18871 Michigan U., Ann Arbor, Inst. of Science and Technology
DATA REDUCTION BY COHERENT OPTICAL SYSTEMS
A. Vanderlugt and F. B. Rotz Mar. 1964 21 p refs
(Contract AF 33(616)-8433)
(Rept. 4594-40-R; AD-432863)

This paper emphasizes some new developments that have bearing on data reduction, while referring only briefly to the theory behind coherent optical systems. Of particular interest is the development of a technique that allows more general operations by linear filtering. Examples of spectral analysis and character recognition will be presented. Author

N64-18880 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
GUIDED COMPLEX WAVES. PART I: FIELDS AT AN INTERFACE
T. Tamir and A. A. Oliner 21 Mar. 1962 63 p refs
(Contract AF 19(604)-7499)
(PIBMRI-1008-62; AFCRL-62-166; AD-286308)

The variety of waves that can be supported by a plane homogeneous interface includes surface waves of the forward and backward type, leaky waves, and several types of spectral complex waves, the latter being characterized by wavenumbers that are complex even though the media involved are not necessarily lossy. The present study views all of these waves as contributions due to poles in several alternative integral representations of a source-excited field, with particular stress placed on the steepest-descent representation. The pole locations, field distributions, and power transport properties are explored in detail for all of the wave types. Author

N64-18888 Vanderbilt U., Nashville, Tenn.
INTERPRETATION OF NEAR AND VACUUM ULTRAVIOLET BAND SPECTRA Quarterly Technical Summary Report No. 3, 1 Dec. 1963-29 Feb. 1964
K. Keith Innes [1964] 3 p refs
(Grant DA-ARO(D)-31-124-G456; ARPA Order 40, Amend. 26)
(AD-433692)

The reactants and environment in a discharge tube were varied in order to determine what elements compose the emitting molecule. It was possible to obtain the emission spectrum in the absence of silicon, but never without oxygen, fluorine, and boron being simultaneously present. A source was developed that is strong enough for obtaining high-resolution photographs of the strongest band from samples enriched with B^{10} or B^{11}. The boron vibrational isotope effect and the character of the resolved rotational fine structure are consistent with a molecule containing only one boron atom (near the center of mass) and probably containing three other atoms. R.T.K.

N64-18903 Innsbruck U., Austria
PROPAGATION OF VLF WAVES IN HIGHLY CONDUCTING MEDIUM Technical Note No. 7
O. Grobner 1 Dec. 1963 16 p
(Contract AF 61(052)-490)
(AFCRL-64-145; AD-434776)

A propagation measurement of VLF waves conducted in the iron-ore mine, Konrad I (Salzgitter), is discussed in detail and compared with the theory for unbounded and homogeneous medium. The results of the measurement differ considerably from this simplified theory in some points, suggesting that the field is very inhomogeneous. Furthermore, a representation is given that makes possible the determination of the conductivity of the studied rock by measuring the function $\vartheta(r,\Delta)$, which is defined and calculated for a number of r and ϑ values. The r refers to distance, ϑ to the angle, and Δ to quantity, according to expression 52 of the second "Annual VLF Report of 1962." I.v.L.

N64-18912 University Coll. of Wales, Aberystwyth (Gt. Brit.)
ABSOLUTE INTENSITIES AND MEAN REFRACTIVE INDICES FROM INFRA-RED DISPERSION DATA Technical Note No. 6
W. H. Prichard and W. J. Orville-Thomas 30 Oct. 1963 12 p refs
(Contract AF 61(052)-691)
(AFCRL-64-217; AD-430815)

Two general relations connecting the refractive index and absolute intensities were tested. Mean refractive indices were obtained for dichloromethane, dibromomethane, and diiodomethane. Author

N64-18915 Space Technology Labs., Inc., Redondo Beach, Calif. Quantum Physics Lab.
A QUANTUM THEORY OF ELEMENTARY PARTICLES
H. C. Corben Aug. 1963 39 p refs
(Contract Nonr-3769(00))
(Rept. 8665-6003-RU000; AD-420626)

The quantum numbers of strangeness S, baryon number B, and isospin I are found to be natural consequences of the generalized field theory of a spinning particle developed in earlier papers, the theory requiring that $S + 21 + 2J$ is even, as observed. The generalized Dirac equation for fermions leads to the correct values of B, S, I_3, and J, and approximately the correct masses for the states n, p, Ξ^0, Ξ^-, N^*_{13}, N^{*0}_{13}, the lowest known states of $I = 1/2$, $J = 1/2$ or $3/2$. The generalized Dirac equation for bosons similarly describes these quantities for the K and K* mesons. The generalized Kemmer equation for fermions yields the correct values of B, S, I_3, J and the masses for the Λ^0, Y^*_0, and Y^*_{03} if the spin of the Y^*_0 is 1/2; and the generalized Kemmer equation for bosons similarly describes a number of the mesonic states with $S = 0$. Author

N64-18916 Virginia U., Charlottesville Research Labs. for the Engineering Sciences
A MAGNETIC WIND TUNNEL BALANCE
H. M. Parker and A. R. Kuhlthau Feb. 1964 19 p refs
(AF AFOSR Grant 62-92)
(AST-3420-105-64U; AFOSR-64-0567; AD-434844)

A preliminary model of a 3-D (three-dimensional) wind-tunnel balance, which has been constructed and operated in low-speed continuum flow, is discussed. The basic idea of this magnetic wind-tunnel balance is that a magnetic sphere, with or without some nonmagnetic model built around it, can be supported in a wind tunnel. The three required components of force can be measured independently (proportional to the gradient coil currents); this implies three control systems, each beginning with a system to sense the proper component of displacement of the sphere and ending with establishing the proper current in the corresponding gradient coil set. An essential feature of the balance is that no, or at least very small, moments are exerted on the model. Consequently, there is, ideally, no control of the angular orientation of the model. The ultimate goal of the balance is to provide a technique of studying the dynamic stability of an aerodynamic configuration in a wind tunnel under conditions of no motion, or small controlled motion, of the center of gravity of the model to provide essentially complete rotational freedom. An intermediate goal is to measure sphere drag in the transition region. I.v.L.

N64-18936 Syracuse U. Research Inst., N.Y.
RESEARCH IN THE FAR INFRARED REGION OF THE SPECTRUM Final Report
Nathan Ginsburg 31 Dec. 1963 72 p
(Contract AF 19(628)-268)
(AFCRL-64-73; AD-434770)

Investigations in three areas of the far infrared spectroscopy were carried out. These were (1) intensities and widths of lines in the rotational spectrum of water vapor, (2) reflection and transmission measurements on crystals at temperatures down to that of liquid helium, and (3) characteristics of some far infrared detectors. Author

N64-18941 Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
ON DETERMINATION OF THE OPTICAL ABSORPTION COEFFICIENT, II
Alfred Kahan Dec. 1963 125 p refs
(AFCRL-63-325(2); AD-435620)

The equation for the optical absorption coefficients α in terms of the average measured reflection and transmission coefficients $\bar{r}$ and $\bar{T}$ is derived. A set of tables of αd, where d is the sample thickness, as a function of $\bar{T}$ in intervals of 0.2 percent for parameters of $\bar{r}$ in 0.5 percent is included. Both $\bar{r}$ and $\bar{T}$ values range between 0 and 100 percent. In addition, tables for the bulk reflectivity R as a function of $\bar{r}$ and $\bar{T}$ are given. Author

N64-18943 Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
ON THE USE OF MAGNETOSTATIC MODES FOR MEASURING SATURATION MAGNETIZATION OF FERRIMAGNETIC MATERIALS
Benjamin R. Capone Jan. 1964 16 p refs
(AFCRL-64-49; AD-435617)

The use of magnetostatic modes as a research tool has been suggested. Attempts to utilize this phenomenon for measuring the saturation magnetization of pure YIG samples and gallium-substituted YIG samples show this method to be quite accurate for the narrow line width pure YIG material. However, in the measurement of gallium-substituted YIG samples, difficulties were encountered in mode identification and interpretation of data. Author

N64-18965 Joint Publications Research Service, Washington, D.C.
SOVIET SYSTEMS DEVELOPMENT AND COMPUTER TECHNOLOGY
10 Apr. 1964 14 p refs Transl. into ENGLISH of 2 articles from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 2, 1964 p 155–158, 181–184
(JPRS-24138; OTS-64-31049) OTS: $0.50

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1. THE EFFECT OF EXTERNAL PERIODIC FORCES ON SINGLE-FREQUENCY VIBRATIONS IN SYSTEMS WITH MANY DEGREES OF FREEDOM N. Ye. Stolyars'ka p 155–158 refs

2. VARIABLE STRUCTURE ALGEBRAIC TRANSFORMERS H. Ye. Pukhov p 181–184 refs

N64-18970 Joint Publications Research Service, Washington, D.C.
THE NATURE OF SOUND-SCATTERING LAYERS
I. B. Andreyeva and Yu. G. Chindonova 21 Apr. 1964 25 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 4, no. 1, 1964 p 112–123
(JPRS-24274; OTS-64-31112) OTS: $0.75

The capacity of marine organisms found in scattering layers to cause various acoustic effects depending upon certain peculiarities of their structure, concentration, and depth of habitation was investigated. Effective scattering cross sections for different animals in sound-scattering layers at various depths were found for: Copepoda, other semitransparent organisms, fish, higher Crustacea, squids, fish with resonant swimbladders, and fish without swimbladders. R.T.K.

N64-18985 California U., Berkeley. Lawrence Radiation Lab.
THE BETA-DECAY ASYMMETRY AND NUCLEAR MAGNETIC MOMENT OF NEON-19
David Albert Dobson (Ph.D. Thesis) 20 Dec. 1963 108 p refs
(Contract W-7405-ENG-48)
(UCRL-11169) OTS: $2.25

The asymmetry parameter in the angular distribution of decay positrons from polarized Ne^{19} nuclei was measured and found to be $A = -0.033 \pm 0.002$. The magnetic moment of Ne^{19} calculated from the resonance frequency and the static magnetic field intensity, and measured with an NMR gaussmeter was found to be $\mu = -1.887 \pm 0.001$ nuclear magnetons. A rotational-model calculation for F^{19} was carried out with the spin-orbit parameter, deformation, and moment of inertia of the nucleus adjusted so that the energies of three excited states agree with experimental values. The predicted magnetic moments for F^{19} and Ne^{19} were found to be 2.74 nm and −1.89 nm, respectively. The predicted moment for Ne^{19} was in good agreement with the measured values, but the predicted moment for F^{19} was too large by 0.11 nm. P.V.E.

N64-18991 Advisory Group for Aeronautical Research and Development, Paris (France)
THE PHYSICAL PICTURE OF FLOW NOISE
Eugen J. Skudrzyk and Gillian P. Haddle (Pa. State U.) Apr. 1963 43 p Presented at the AGARD Specialists' Meeting on The Mechanism of Noise Generation in Turbulent Flow, Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963
(AGARD-462)

The study of flow noise is based on exact computation, on model studies, and on statistical analysis. Measurements were performed in the water tunnel with the aid of buoyant units. The effect of surface roughnesses was studied with a rotating cylinder. Special attention is given to radiated noise, since hydrophones used in underwater acoustics are large and record radiation noise only. Flow noise was reduced by tripping the boundary layer by coating the surface with sound-absorbent varnishes. Flow noise can probably be reduced by reducing wall vibrations. Author

N64-18993 Bureau of Mines, Laramie, Wyo.
A METHOD OF OBTAINING THE ULTRAVIOLET AND VISIBLE SPECTRA OF INSOLUBLE MATERIALS. USE OF A LOW-MOLECULAR-WEIGHT POLYETHYLENE AS A MATRIX MATERIAL
F. R. Mc Donald and G. L. Cook 1964 14 p refs Work done in cooperation with Wyo. U.
(BM-R I-6439)

A technique has been developed to obtain the ultraviolet and visible spectra of insoluble materials by utilizing low-molecular-weight polyethylene as a dispersion medium. The sample is dispersed in molten polyethylene and pressed into a film, and a portion of the film is inserted into the instrument to obtain the spectrum. Author

N64-18995 California U., Berkeley. Lawrence Radiation Lab.
STUDIES IN MOLECULAR STRUCTURE: I. NEAR-ULTRAVIOLET SPECTRUM OF TETROLALDEHYDE. II. SIMPLE MOLECULAR ORBITAL THEORY OF THE DICHLOROETHYLENES. III. HIGH-TEMPERATURE MICROWAVE SPECTROSCOPY
James S. Muirhead (Ph.D. Thesis) 29 Jan. 1964 94 p refs (Contract W-7405-ENG-48)
(UCRL-11229) OTS: $2.00

(1) The near-ultraviolet absorption spectrum of tetrolaldehyde vapor has been examined. The weak absorption appearing in the 300 to 400-mμ region has been assigned as the $n^{-}\pi^{*}$ transition, and a vibrational analysis places the 0–0 transition at 26,620 cm^{-1} and yields a value for the C=O stretch frequency in the π^{*} state of 1,036 cm^{-1}. Two other regions of absorption are observed in the 200 to 300-mμ range. (2) A simple molecular orbital treatment, including overlap, has been employed to compute the electron distribution and energy eigenvalues of the dichloroethylenes. The Coulomb and exchange integrals used were those previously employed for vinyl chloride. Comparison with available photoionization potentials, electric dipole moments, and nuclear quadrupole data show, on the whole, a satisfactory agreement between observed and calculated properties. (3) A high-temperature microwave spectrometer has been assembled to operate in the temperature range up to 1,100° C. The absorptions due to OCS and KCl have been observed, and the sensitivity of the spectrometer has been determined. The design, construction, and assembly of the spectrometer are described. Author

N64-19001 Air Force Systems Command, Kirtland AFB, N. Mex. Research and Technology Div.
TRANSIENT RESPONSE OF CERTAIN ION CHAMBERS TO SHORT RADIATION PULSES
Peter M. Livingston Sep. 1963 33 p refs
(RTD-TDR-63-3063; AD-418589)

A procedure for uncoupling the charge-transport and electric-field equations under certain restrictions of no recombination and dose-rate limitation in a parallel-plate ion chamber is given. A solution to the first uncoupled transport equation for a flat-topped ionization pulse, without diffusion, is obtained by finding the appropriate Green's function, and the subsequent current densities and external circuit current are derived. The usual assumption of neglecting diffusion is shown to be valid for most cases involving ion transport by an examination of the general form of the external chamber current. Variations of the external circuit current with the radiation pulse width and the ratio of negative-to-positive ion mobilities are given. An attempt to "fit" an observed record is discussed. Author

N64-19016 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 34, PART A
15 Apr. 1964 39 p refs
(Contract AT(40-1)-2847)
(GEMP-34A) OTS: $1.00

Research activities are reported in the following areas: (1) In the study of radiation effects in BeO the first measurements were obtained on specimens irradiated at low fluxes. The first data on the EBOR (experimental beryllium oxide reactor) composition, which contains a glass-phase additive, were obtained in the low flux tests. Further measurements were completed on the helium content, helium bubbles, and defect clusters in irradiated samples. (2) In the study of fission gas diffusion in unfueled ceramic materials, the ion gun was completed, and the lattice orientations with respect to the plane crystal surfaces were determined for 7 monocrystalline targets of sapphire. (3) Fission product transport processes in refractory metal fuel systems were studied. Arc-cast tantalum cathodes of wire, sheet, and hollow cylinders, which were resistively heated, plasma heated, or cold, were used to analyze the effects of applied voltage, tube current, cathode temperature, cathode pressure, and cathode–anode separation distance when krypton is introduced into the tantalum cathodes under glow discharge. (4) Internal conversion ceramic fuel elements were also studied. R.T.K.

N64-19034 Hughes Aircraft Co., Fullerton, Calif.
TRANSIENT RADIATION EFFECTS IN PASSIVE PARTS
C. W. Perkins 29 Apr. 1963 18 p Presented at the TREE Symp.

Three problems in the measurement of transient radiation effects in passive parts are discussed. One of the major problems, particularly around a pulsed reactor, has been the interfering effects on the coaxial cable used in these tests. Another problem that was investigated was the removal of air ionization leakage effects. For most passive parts this leakage forms a major portion of the total transient effect. A third area of investigation was the development of a technique for detecting and measuring polarization effects or change in capacitance. These effects form a small part of the total internal effect in passive parts and, in a simple measurement with d.c. voltages, cannot be separated from the leakage component. Use was made of the relative difference in the frequency dependence of the two effects in attempts to develop a technique for this purpose using a.c. voltages of varying frequencies. R.T.K.

N64-19041 European Atomic Energy Community, Brussels (Belgium)
MICRODETERMINATION OF THE VISCOSITY OF POLYPHENYLS [BESTIMMUNG DER ZAHIGKEIT VON POLYPHENYLEN MIT HILFE EINER METHODE FUR KLEINE SUBSTANZMENGEN]
G. Friz Joint Nucl. Res. Center, Ispra Estab. (Italy) [Feb.] 1964 43 p refs In GERMAN; ENGLISH summary
(EUR-594.d) Available from the Belgian American Bank and Trust Co., N.Y., Account No. 121.86: 60 Belg. Fr.

A micromethod for measuring the viscosity of liquids in the temperature range from 20° to 450° C is described. Concerning diphenyle, o-, m-, p-terphenyle, and two technical mixtures, experimental results are communicated. In the theoretical part, the exploitation formula is substantiated, and the limits and errors of the method are discussed. The overall error is estimated to be 1.5%. The viscosity range extends from 0.2 to 10 cp. The required volume of test substance is about 0.2 cm^3. Author

N64-19042 European Atomic Energy Community, Brussels (Belgium)
DYNAMIC NUCLEAR POLARIZATION IN LIQUIDS AT HIGH MAGNETIC FIELDS
K. H. Hausser Joint Nuclear Res. Center, Ispra Estab. (Italy), 1964 15 p refs Presented at 13th Ann. Meeting of Soc. of Physical Chem., Paris, 4–7 June 1963
(EUR-483.e) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 121.86: 40 Belg. Fr.

The dynamic nuclear polarization (DNP) by relaxation interaction has been investigated in some detail in recent years. The investigation of DNP is extended both theoretically and experimentally from two types of spins to systems of three and more types of spins and to triple resonance. The possibility of applying DNP for signal enhancement in high-resolution nuclear

magnetic resonance (NMR) is investigated with particular attention to the "high field limit" of this mechanism. Measurements of the DNP at different temperatures and related measurements on line width and relaxation lead to the conclusion that the high field limit in a nonviscous solvent as acetone at room temperature is of the order of 10 kilogauss. Author

N64-19045 Pennsylvania State U., University Park Coll. of Engineering
CONTROL OF THE VEHICULAR BRAKING PROCESS USING AN OPTIMALIZING TECHNIQUE Report No. 9
Robert M. Vijuk (M.S. Thesis) Sep. 1963 109 p refs

The braking process was analyzed by formulating a mathematical model of a system consisting of a braked wheel, a massive body carried by the wheel, and a coupling action between the wheel and the surface on which it travels. The response of the system under a control action that would simultaneously provide for minimum stopping distances and stable operation was also studied. The possibility of using the deceleration of the wheel as an indication of whether the brakes should be applied more heavily or released was examined. To determine if the braking process is theoretically amenable to control by a continuous test-signal optimalizing technique, the equations that describe the system were linearized and combined to obtain the system's transfer functions. The transfer functions were then transformed into the frequency domain, and the effect of the slip on the response of the system was investigated. The signals that can be used by a continuous test-signal optimalizing control system to provide control of the braking process were discussed, and a possible control scheme was presented. R.T.K.

N64-19050 Pennsylvania State U., University Park Coll. of Engineering
THE SINKAGE OF FLAT PLATES ON SMOOTH AND ROUGH SURFACES Report No. 10
Desmond F. Moore (Ph.D. Thesis) Dec. 1963 156 p refs

Although the channel flow between asperities of a rough surface is extremely complex, a satisfactory prediction of the sinkage behavior of flat plates in noninertial descent onto these surfaces can be obtained by using only surface geometry. Although the asperities may vary in shape and distribution, the height, size, and number per unit area must be constant for any one surface. The spacing, size, and shape factors can be computed for each surface and these substituted into a dimensionless number. For most surfaces, the spacing and size factors appear to be more significant than the shape factor. Probably more than one type of rough surface will have the same dimensionless number, and in this sense the latter is not a unique measure of surface geometry. When two or more surfaces have the same dimensionless number, the drainage properties of these surfaces are the same. Author

N64-19057 Atomics International, Canoga Park, Calif.
REACTOR KINETICS MEASUREMENTS IN HOMOGENEOUS, STATIONARY, LINEAR EXTENDED SYSTEMS
M. N. Moore 15 Apr. 1964 26 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7020) OTS: $0.50

A partial differential equation of sufficient generality to include most linear space-dependent reactor kinetic models is considered from the point of view of its modal solution. The vibrations of this system, resulting from an arbitrary source located at a boundary, are studied. The dispersion law of the system can best be measured from the information obtained from a minimal number of measurements in space and from accurate and detailed measurements in time. A method for measuring this dispersion law, without accurate knowledge of the boundary and initial conditions in the experiment, is presented. From the dispersion law measurements, the physical parameters of the system may then be obtained. Author

N64-19058 Mound Lab., Miamisburg, Ohio
MOUND LABORATORY PROGRESS REPORT FOR NOVEMBER 1963
J. F. Eichelberger, G. R. Grove, and L. V. Jones 30 Nov. 1963 26 p refs
(Contract AT(33)-1-GEN-53)
(MLM-1178)

Research activities are presented in the following areas: (1) isotope separation and purifications—helium-3, neon isotope separation, krypton isotope separation, carbon-13, (2) alpha and neutron sources, and (3) radioelements—residue adsorption, determination of coincidence correction, polonium research, and promethium separation and purification. R.T.K.

N64-19061 European Organization for Nuclear Research, Geneva (Switzerland)
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON HYPER-FRAGMENTS, ST. CERGUE, 28-30 MARCH 1963
W. D. Lock, ed. 2 Jan. 1964 270 p refs
(CERN-64-1)

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N64-19070 Oak Ridge National Lab., Tenn. Chemical Technology Div.

HANDBOOK OF SHIELDING REQUIREMENTS AND RADIATION CHARACTERISTICS OF ISOTOPIC POWER SOURCES FOR TERRESTRIAL, MARINE, AND SPACE APPLICATIONS

E. D. Arnold Apr. 1964 221 p refs

(Contract W-7405-ENG-26)

(ORNL-3576) OTS: $3.00

Calculations have been made of the radiation intensities from shielded and unshielded sources fabricated from 17 isotopes that show promise for use in isotopic power or radiation applications. Source sizes in the range of 100 to 20,000 thermal watts were evaluated. All shielded sources were assumed to be attenuated by iron, lead, and uranium; and in those cases where the source also emitted neutrons, neutron and gamma attenuation through water was determined. The isotopes studied and their physical form are as follows: Co^{60} (metal), Kr^{85} (liquefied gas), Sr^{90} (oxide and titanate), Zr-Nb^{95} (oxide), Ru^{106} (metal), Cs^{137} (glass), Ce^{144} (oxide), Pm^{147} (oxide), Tm^{170} and Tm^{171} (both as oxides), Tl^{204} (metal), Po^{210} (metal matrix with void space for gas collection), U^{232} (oxide), Th^{228} (oxide matrix with void space for gas collection), Pu^{238} (oxide), Cm^{242} (oxide matrix with void space for gas collection), and Cm^{244} (oxide). Author

N64-19079 ARO, Inc., Arnold Air Force Station, Tenn.

MOLLIER DIAGRAM FOR EQUILIBRIUM AIR

Mar. 1964 2 p refs Oversized chart

A chart, Mollier Diagram for air, is given showing the coordinated dimensions of pressure and temperature versus enthalpy for air. The information shown on the chart is composed of air and various gases and their thermodynamic properties while in chemical equilibrium. The chart is developed in order that the heat of vaporization of oxygen and nitrogen and the coordinates for the function of enthalpy could be incorporated. A.L.B.

N64-19103 General Electric Co., King of Prussia, Pa. Missile and Space Div.

THEORETICAL CALCULATION OF CROSS-SECTIONS OF IMPORTANCE TO ATMOSPHERIC DEIONIZATION Scientific Report No. 3

C. W. Baulknight and M. H. Bortner Jan. 1964 47 p refs

(Contract AF 19(604)-8820)

(AFCRL-64-142; AD-435980)

A program was carried out to obtain order-of-magnitude values for rate constants for certain ion–ion recombination reactions. The technique used for these calculations was a curve-crossing technique. It essentially involved the calculation of the Hamiltonian for the process, the use of this Hamiltonian in the calculation of the probabilities of transition at the curve-crossing points, and the use of the probabilities in the calculation of the cross sections, and rate constants. The rate constants so obtained are:

$$(1) O^+ + O^- \rightarrow O + O,\ k = 5.5 \times 10^{-7} T^{-1/2}; \text{ and}$$

$$(2) N^+ + O^- \rightarrow N + O,\ k = 8.4 \times 10^{-7} T^{-1/2}.$$

The report also includes a discussion of methods, which have been reported in the literature, for calculations on the dissociative recombination type of reaction. Author

N64-19105 Army Materials Research Agency, Watertown, Mass.

THE ANOMALOUS DIFFRACTION OF X-RAYS

R. J. Weiss Dec. 1963 5 p

(AMRA-TR-63-32; MRL-143; AD-428564)

In theoretical treatments of the anomalous diffraction of X-rays, the expression for the integrated intensity is not specifically given because the integral is cumbersome. A closed solution in terms of the zero-order Bessel function (imaginary argument) has been found. Author

N64-19106 Army Materials Research Agency, Watertown, Mass.

ELECTRIC QUADRUPOLE INTERACTIONS IN RARE EARTH IONS

A. J. Freeman and R. E. Watson (Bell Telephone Labs.) Dec. 1963 12 p

(AMRA-TR-63-33; MRL-139; AD-429189)

Electric quadrupole interactions in rare earth ions arising from electric field gradients due to valence electrons (q_{4f}) and/or crystal fields external to the ion (q_{lat}) are discussed. The contribution of the Sternheimer antishielding factors to both q_{4f} and q_{lat} is calculated for the Ce^{3+} ion using the method (based on the unrestricted Hartree–Fock formalism) reported earlier. The ionic antishielding factor (γ_∞) is −73.5, and the total ionic contribution to the electric field gradient can be comparable in magnitude (and may be opposite in sign) with the valence electron contribution (augmented by the internal antishielding factor). The possible relation of these results to the temperature dependence of measured electric quadrupole interactions is noted. Author

N64-19116 Naval Radiological Defense Lab., San Francisco, Calif.

SOME GAMMA-RAY SHIELDING PROPERTIES OF FINITE STEEL SLABS

G. E. Langer and B. W. Shumway 2 Jan. 1964 46 p refs

(USNRDL-TR-707; AD-433658)

Some gamma-ray shielding properties of plane-steel slabs placed between a point source and a point detector have been investigated. Each slab was placed at five selected points between the source and the detector to observe the variation in B_γ-1 with slab position. The dose buildup due solely to singly scattered photons was calculated for the slabs. The measured values of dose buildup are compared with the calculations. A similar set of measurements has been made for 1.25-Mev photons incident upon smaller steel slabs. The effect of interchanging two separated slabs of different thicknesses was measured for two slab pairs; one, 0.25 and 0.75 in. thick, the other, 0.50 and 1.00 in. thick. Dose buildup due to separated slab pairs was measured. It was also estimated from single slab data, and the results were compared. Author

N64-19123 Carnegie Inst. of Tech., Pittsburgh, Pa.

NUCLEAR DEFORMATIONS IN THE PAIRING-PLUS-QUADRUPOLE MODEL I. THE SINGLE-j SHELL

Michael Baranger and Krishna Kumar Mar. 1964 43 p refs

(Contract Nonr-760(15))

(AD-436428; Tech. Rept. 15)

The motivation and basic assumptions of the pairing-plus-quadrupole model are reviewed. Analytical and numerical applications are made to the single-j shell, demonstrating the competition between the deforming effect of the quadrupole force and the spherifying effect of the pairing force. When deformed, the single-j shell is always axially symmetric. Cases are found for which the potential energy of deformation has a spherical minimum and a deformed minimum simultaneously. The results are valid for any j. The importance of zero-point motion is studied and decreases when j increases. Author

N64-19126 Massachusetts Inst. of Tech., Cambridge Aeroelastic and Structures Research Lab.
SURVEY OF HYPERVELOCITY IMPACT INFORMATION II
Arfon H. Jones, John F. Polhemus, and Walter Herrmann Dec. 1963 188 p refs
(Contract AF 19(628)-500)
(ASRL-99-2; LL-11-67; ESD-TDR-63-671; AD-432815)

This survey pertains to impact on quasi-infinite targets, finite thickness targets, thin plate targets, and shielded targets. The data for impact on quasi-infinite targets are compared with a logarithmic empirical expression proposed previously and found to be in good agreement for appropriate values of the empirical constants. New experimental information gathered for impact on finite thickness targets is considered. A qualitative description is given of the perforation and cratering process in thin targets and shielded targets. Data for impact on these targets are presented in graphical form and compared with available theories. In addition, data have been gathered for impact on composite targets. Based on the analysis of the data a qualitative description is given for the perforation process and mode of damage of the ablative and metallic plates. Author

N64-19127 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
VIBRATION OF SPHERE FOR DETERMINING THE DILATATIONAL CONSTANTS OF VISCO-ELASTIC MATERIALS
Tung-Ming Lee Feb. 1964 12 p refs
(CRREL Res. Rept. 132; AD-435610)

The forced vibration problem of a finite sphere with an exciting source embedded inside it has been treated. The source is assumed to oscillate sinusoidally, and the complex dilatational modulus is used to describe the motion inside the sphere. It is found that if the outer surface of the sphere is restrained from radial displacement, the ratio of the amplitude of a midpoint (between the outer surface of the sphere and the inner exciting source) to the amplitude of a point on the exciting source could be used as an indication of the dilatational properties of the sphere. Therefore, from the criterion of maximum amplitude ratio in conjunction with the frequency, the dilatational properties of a testing material can be determined. This method can be applied to viscoelastic fluids as well as solids. Author

N64-19130 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
THE THEORY OF HYPERVELOCITY IMPACT Summary Report
J. M. Walsh, W. E. Johnson, J. K. Dienes, J. H. Tillotson, and D. R. Yates 31 Mar. 1964 69 p refs
(Contract DA-04-495-AMC-116(X); ARPA Order 71-62)
(GA-5119; AD-436251)

Solid–solid impact at velocities in the meteoric range is discussed. A continuous Eulerian hydrodynamic code is used to numerically integrate the flow equations for several series of impact problems. The impact velocity, the projectile shape, the density of the projectile, and the equation of state of the interacting materials are varied. Impact crater dimensions are found to increase as the 0.58 power of the impact velocity. Projectiles of the same mass but different densities have the same overall impact effects on the target, for velocities above 10^6 cm/sec. One-dimensional and axisymmetric impacts are also computed for materials with an ideal-gas equation of state. These calculations provide some important comparisons with analytical work on the problem of hypervelocity impact. Many of the concepts used in solid–solid impact are already present in the one-dimensional problem. The theory of impact is discussed in detail. Author

N64-19133 Cambridge Acoustical Associates, Inc., Mass.
MUTUAL AND SELF-RADIATION IMPEDANCES IN AN ARRAY OF FREE-FLOODING, COAXIAL, SPACED RING TRANSDUCERS
Miguel C. Junger 16 Mar. 1964 35 p refs
(Contract Nonr-2739(00))
(U-178-48; AD-434698)

Expressions are derived for the mutual and self-radiation impedances between the elements in an array of coaxial, free-flooding, axially spaced ring transducers undergoing axisymmetric, radial vibrations. An integral equation is constructed that defines the unknown radial velocity distribution $\alpha(z)$ between elements and on the two semi-infinite cylindrical surfaces that bracket the array. The radiation impedance is the sum of two components; the impedance evaluated by means of the mathematical model originated by Robey, which assumes that the active array element is located on an infinite rigid cylindrical baffle, and the impedance associated with the unknown velocity distribution $\alpha(z)$, which is a correction factor to Robey's impedance. Four methods are presented for obtaining the function $\alpha(z)$: a perturbation solution that can be used as the starting point in a more refined iteration-type solution, a finite-difference solution of the integral equation, and variational solution. Author

N64-19134 Massachusetts Inst. of Tech., Cambridge
LABORATORY FOR INSULATION RESEARCH Progress Report No. XXXIV
A. R. von Hippel Jan. 1964 76 p refs
(Contract Nonr-1841(10); Contract Nonr-1841(88); Contract AF 19(628)-395; Contract AF 33(616)-8353; Contract AF 19(604)-8483 et al)
(AD-436276)

Research activities are reported in the following areas: (1) crystal physics, (2) magnetics, (3) magnetic spectroscopy, (4) structure analysis, (5) thin-film solid-state studies, (6) mass spectroscopy, (7) magnon–phonon spectroscopy, and (8) dielectrics research. R.T.K.

N64-19140 Tracerlab, Inc., Richmond, Calif. Western Div. Labs.
RADIOLOGICAL MONITORING STUDY
A. L. Baietti and A. Zirkes 15 Nov. 1963 219 p refs
(Contract OCD-OS-62-151)
(AD-432345)

This study evaluated radiological monitoring systems for use following a nuclear attack. The recommended system uses a combination of flash reports for preparing fallout contour maps, unshielded land vehicles, and monitoring on foot. The major advantages of this combination are low cost, simplicity, and low personnel exposure. Author

N64-19172* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS V: AN EXPANSION METHOD FOR CALCULATING ATOMIC PROPERTIES: II. TRANSITION PROBABILITIES

M. Cohen and A. Dalgarno Mar. 1964 37 p refs
(NASA Contract NASw-840)
(NASA CR-53747; GCA-TR-64-6-N) OTS: $3.60 ph

An earlier expression for the expectation value of a single-electron operator stationary with respect to first-order variations of the state wave function, has been generalized to the case of an off-diagonal matrix element connecting two different states. Explicit calculations are carried out of the probabilities of dipole transitions between configurations $1s^a\ 2s^b\ 2p^c$ and $1s^a\ 2s^{b-1}\ 2p^{c+1}$ for all members of the isoelectronic sequences from helium to neon, and the importance of taking into account the mixing of degenerate configurations is demonstrated. The accuracy is at least comparable to that of the Hartree–Fock approximation, and in cases where degeneracy is important, it is considerably superior. Author

N64-19178 Naval Research Lab., Washington, D.C.
TRANSMISSION OF LIGHT SIGNALS OVER THE HORIZON
J. A. Curcio *In its* Rept. of NRL Progr. Dec. 1963 p 8–15
OTS: $1.25

This is a report on a technique for transmitting light signals out to distances beyond the geometrical horizon. Experimental data are presented that show the signal strength of near-infrared light (7,400 to 10,000 A) as a function of distance out to 90 km. Some recent daytime experiments over a 45-km path indicate that a light source of about 1-mw peak power would be needed for a system to work in daytime when the meteorological range is as low as 9 km. Author

N64-19182 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CHARGE TRANSFER IN ELECTROSTATIC GENERATORS WITH A DIELECTRIC TRANSFER MEDIUM
Vaclav Hamata 2 May 1963 19 p refs Transl. into ENGLISH from Prace Ustavu Elektrotech. (Prague), v. 8, 1957 p 121–136
(FTD-TT-63-247/1+2+3+4; AD-405715)

This paper describes the principle of the newly developed rotary electrostatic generators with dielectric transfer media, which produce the highest power yet achieved with this type of device. A theoretical analysis of charge transfer is presented, and the principle of natural transfer is explained. These theoretical considerations lead up to the calculation of the generator current. The formulas cited are verified by experimental results, which are in close agreement with the calculated results. Author

N64-19190 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CHARGED-PARTICLE ACCELERATORS
B. S. Ratner 8 Feb. 1963 119 p refs Transl. into ENGLISH of the book "Uskoriteli Zaryazhennykh Chastits" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1960 p 1–112
(FTD-TT-62-957/1+2; AD-298239)

This book discusses in simple language the latest progress and the developmental history of accelerator technology, explains the basic principles of accelerator operation, and gives the necessary information concerning the structure of atoms, the atomic nucleus, and the main types of nuclear reactions. Author

N64-19195 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
IS A GRAVITY SCREEN POSSIBLE?
Oleg Kostko 25 Apr. 1963 6 p Transl. into ENGLISH from Zarya Vostoka (USSR), 5 Jan. 1963 p 4
(FTD-TT-63-155/1; AD-408499)

During the 1961 total solar eclipse in Rostov-on-Don, scientists repeated a 1954 French experiment in which the moon apparently had screened the solar gravitational force and changed the plane of oscillation of a pendulum. In the later experiment, the instruments were thoroughly insulated from outside influences. The change in the plane of oscillation of the pendulum was of a random nature and had no connection with the eclipse. The gravimeter did not react to the eclipse. The authors believe that present-day instruments are insufficient for observing the effect of screening the sun during an eclipse. R.L.K.

N64-19199 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERACTION BETWEEN A SHOCK WAVE IN AN ELASTO-PLASTIC MEDIUM AND A NONRIGID WALL
G. M. Lyakhov and N. I. Polyakova 26 Apr. 1963 16 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. i Tekhn. Fiz. (Moscow), no. 5, Sep.–Oct. 1962 p 89–95
(FTD-TT-63-360/1+2+4; AD-415655)

The interaction between a wall and a wave in an elasto-plastic medium with an alternating sign of curvature of the stress–strain dependence $\sigma = \sigma(\epsilon)$ was examined earlier. The case of small stresses lying on the concave section of the diagram $\sigma = \sigma(\epsilon)$, when the wave has no pressure jump at the front, has been investigated. Based on earlier studies, a solution is given to the problem of the interaction between a plane wave and a nonrigid wall or the boundary of media in the case of large stresses, corresponding to the section of the diagram $\sigma(\epsilon)$, which is convex relative to axis ϵ. Here the wave is a shock wave. Author

N64-19204 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE CALCULATIONS OF SPECTRAL ABSORPTION IN HEATED AIR
D. R. Churchill, S. A. Hagstrom, and R. K. M. Landshoff Dec. 1963 142 p refs
(Contract DASA-49-146-XZ-198)
(Rept. 3-27-63-4; DASA-1465; AD-436885)

The spectral absorption coefficient of heated air has been calculated over the frequency interval and temperature range where electronic transitions in diatomic molecules are the dominant mechanism. With the aid of experimentally determined constants, the spectra of six important band systems have been theoretically reconstructed. These spectra and the corresponding line intensities have been preserved in the form of a magnetic tape atlas. Average absorption coefficients and their role in radiative transfer are discussed. A method of calculating group absorption coefficients based on a sampling technique is described. Digital computer programs based on this procedure have been used to compute optical transmissions through heated air. Typical results of the calculation are presented. Author

N64-19243 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
ON THE K_{10} TO 2 π TRANSITION IN THE UNITARY SYMMETRY SCHEME
Michel Gourdin Feb. 1964 4 p refs
(Th. 44)

It is shown that the U-spin considerations are sufficient to forbid the decay $K_{10} \rightarrow \pi^0 + \pi^0$ and with the help of the $|\Delta I| = 1/2$ rule, the transition $K_{10} \rightarrow \pi^+ + \pi^-$ is also forbidden. E.W.

N64-19244 Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France)
NOTE ON NON LEPTONIC DECAYS OF HYPERONS
Michel Gourdin Feb. 1964 5 p refs
(Th. 45)

The weak interaction Lagrangian is assumed to belong to an octuplet representation of SU(3) and, as a consequence, the rule $|\Delta I| = 1/2$ follows immediately. It is then possible to relate the S wave parts of the observable amplitudes by the relation

$$2A(\Xi^- \rightarrow \Lambda^0 + \pi^-) = A(\Lambda^0 \rightarrow p + \pi^-) + \sqrt{3}A(\Sigma^+ \rightarrow p + \pi^0)$$

as pointed out by Gell-Mann. This note derives the same relationship by using only simple arguments. E.W.

N64-19247 North American Aviation, Inc., Canoga Park, Calif. Atomics International Div.
PHASE EQUILIBRIA-FREE ENERGY RELATIONSHIPS IN LIQUID SODIUM SYSTEMS
D. L. Johnson 15 Apr. 1964 42 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8381) OTS: $1.00

Partial-molal enthalpy and entropy of solution of several solutes are calculated by setting up computer programs from solubility data for 15 mathematical models. Iron, magnesium, nickel, and silver exhibit negative nonideality with respect to entropy, and slightly positive or negative nonideality with respect to enthalpy. Calcium, Na_4Sn, and sodium (gold solute) exhibit ideality with respect to entropy and, except for sodium (gold solute), positive nonideality with respect to enthalpy. Intermetallic compounds between sodium and selenium, cadmium, bismuth, tellurium, antimony, and lead exhibit large negative nonideality with respect to both entropy and enthalpy. Carbon exhibits large negative nonideality with respect to entropy. Sodium hydride and sodium oxide exhibit positive enthalpy and entropy with respect to pure solid. A comparison of solution free-energy data permits the evaluation of solution behavior and comparative stability in purification and transfer processes. Author

N64-19255* Minnesota U., Minneapolis
THERMAL RADIATION ABSORPTION IN RECTANGULAR-GROOVE CAVITIES
E. M. Sparrow and V. K. Jonsson Repr. from J. App. Mech. [1962] p 1-8 refs Presented at the ASME Winter Ann. Meeting, N.Y., 25-30 Nov. 1962
(NASA Grant NsG-137-61)
(ASME Paper 62-WA-52)

The amount of energy absorbed when a stream of external radiation enters a rectangular-groove cavity has been calculated for a variety of surface conditions, cavity depths, and incident energy distributions. The surfaces of the cavity are either diffuse reflectors or specular reflectors, and a wide range of reflectivity values has been considered. The incoming radiation is either diffusely distributed across the cavity opening or else arrives in a bundle of parallel rays. The results show that for diffuse incoming radiation, a specular cavity absorbs more effectively than does a diffuse cavity. For incoming radiation in a parallel ray bundle, the comparison depends on the angle of inclination of the rays. Author

N64-19269 Admiral Corp., Chicago, Ill.
EFFECTS OF NUCLEAR RADIATION ON FREQUENCY CONTROL DEVICES Third Quarterly Progress Report, 1 Mar.-31 May 1963
B. Gerstein, A. Fueyo, and F. Trainor 28 Jun. 1963 46 p refs
(Contract DA-36-039-AMC-00002(E))
(G3988-Q3-3; AD-422354)

The final version of the phase detector for measuring of small transient phase-angle changes in quartz crystal units exposed to simulated nuclear weapons environment is described. The present system has a resolution of better than 10:1 compared to the dot system used in previous studies. The final version of the oven temperature remote control system for the precision crystal unit ovens is also described. The stability of the system has been increased by the use of a differential amplifier in the bridge control circuit. Preliminary tests of the equipment were made in a linear accelerator, and results are described. Author

N64-19281 Los Alamos Scientific Lab., N. Mex.
SCATTERING FACTORS COMPUTED FROM RELATIVISTIC DIRAC-SLATER WAVE FUNCTIONS
D. T. Cromer and J. T. Waber 21 Apr. 1964 224 p refs
(Contract W-7405-ENG-36)
(LA-3056) OTS: $3.00

Scattering factors for a total of 208 neutral atoms, positive ions, and a few negative ions are given in tabular form and as 9-parameter analytic functions. These scattering factors have been computed from relativistic self-consistent field wave functions that include Slater's approximate exchange correction. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see:* 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-18566 Air Force Systems Command, Griffiss AFB, N.Y. Rome Air Development Center
PLASMA DIAGNOSTICS USING THE RAMAN EFFECT
Raymond P. Urtz, Jr. Mar. 1964 84 p refs Theoretical Portion of Work Performed by Republic Aviation Corp.
(Contract AF 30(602)-3071)
(RADC-TDR-64-5; AD-434761)

A novel plasma diagnostic technique is presented that utilizes the Raman scattering of a laser beam from a plasma. Detection of the Raman scattering will provide qualitative information on the molecular and ionic species present in a plasma. By measuring the relative intensities of the Stokes and anti-Stokes Raman lines, determination can be made of the density and temperature of the individual species present in a plasma. The theory correlating the Raman intensity with the species density and temperature is presented along with preliminary experimental results. The applicability of this technique in connection with various types of plasmas is shown. Author

N64-18601 New York U., N.Y. Courant Institute of Mathematical Sciences
WAVE PROPAGATION IN VARIABLE MEDIA Final Report, 1 Apr. 1958-31 Oct. 1963
Morris Kline Oct. 1963 12 p refs
(Contract AF 19(604)-3495)
(AFCRL-64-28; AD-432987)

The research described is in the field of wave propagation in variable media and related mathematical problems. The

completed work falls into several categories. The mathematical problems of inverse scattering, for which the primary physical application is the determination of the characteristics of the ionosphere from obtainable physical measurements, are considered. Another area of investigation was the fields of geometrical optics and the closely related questions of asymptotic expansions. The problems of multiple scattering and wave propagation in random media were also studied. In the field of magnetohydrodynamics, two reports were issued—the first presents a geometrical optics method for analyzing propagation phenomena in magnetohydrodynamics; the second discusses the solution of Maxwell's equations in the transition region separating a uniform Maxwellian plasma from its magnetic field. R.T.K.

N64-18603 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
FOCUSING BY AN ANISOTROPIC PLASMA INTERFACE Scientific Report No. 3
L. B. Felsen 25 Oct. 1963 31 p refs
(Contract AF 19(628)-2357)
(PIBMRI-1202-63; AFCRL-63-584; AD-433167)

When an electromagnetic source confined in a homogeneous, anisotropic plasma half space radiates into the exterior medium, focusing effects may occur wherein the influence of the plane interface bounding the plasma is similar to that of an optical lens. The existence and location of the caustics and focus depend on the various plasma parameters, in particular on the strength and orientation of the externally applied magnetic field, and the refractive index curves for the medium may be used advantageously for the prediction of their properties. After a qualitative discussion pertaining to the general gyrotropic case, a detailed field evaluation for line source and dipole excitation is carried out for the special problem of uniaxial anisotropy, corresponding to an infinitely strong external magnetic field. In this instance, the ray system and the caustics may be described in simple terms, and expressions are given for the fields inside or outside the focusing region. Author

N64-18627 Pittsburgh U., Pa. Atomic and Plasma Lab.
RECOMBINATION OF MOLECULAR POSITIVE IONS WITH ELECTRONS Technical Report No. 3
M. A. Biondi, T. R. Connor, C. S. Weller, and W. H. Kasner (Westinghouse Research Labs.) Apr. 1964 32 p refs
(Contract Nonr-624(13))
(APP-5; AD-434907)

Results of studies of the recombination of electrons with molecular positive ions are presented. Theoretical arguments indicate that the dissociative process—in which a molecular ion captures an electron without change of energy, forming an unstable excited molecule that then dissociates—provides a highly efficient recombination mechanism. The nature of the process responsible for the large recombination rates observed in laboratory afterglow studies is investigated using combined microwave, optical spectrometric and interferometric, and mass spectrographic techniques. Dissociative recombination is shown to be the process operative in the laboratory studies, since it is found that (1) molecular positive ions must be present to observe a large recombination rate, (2) when diatomic ions are present, excited atoms are formed in the recombination process, and (3) these excited atoms have kinetic energy of dissociation substantially in excess of thermal energy. Author

N64-18691 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PLASMAS
12 Nov. 1963 10 p Transl. into ENGLISH from Nauka i Zhizn, no. 6, 1963 p 33–35
(FTD-MT-63-188; AD-434973)

The thermal and optical properties of plasmas are reviewed, and the construction of a gas quantum generator is discussed. R.T.K.

N64-18704 Minnesota U., Minneapolis Plasma Physics Lab.
STUDY OF COLLISION PROCESSES IN GASEOUS PLASMAS Semi-Annual Technical Report No. 1
H. J. Oskam, ed. Feb. 1964 95 p refs
(Contract Nonr 710(37); NSF Grant GP-559; Proj. Defender)
(AD-434786)

Measuring equipment for the study of collision processes at the thermal energies of the plasma constituents is described. This equipment includes: (1) a microwave measuring system for electron-density time-dependence measurements; (2) a transit-time mobility tube, mass-mobility spectrometer, and a gas-handling system for ion-mobility measurements; (3) a quadrupole mass spectrometer, a hyperbolic quadrupole bakable mass spectrometer, and a rod-type quadrupole bakable mass spectrometer; and (4) a simultaneous light-emission, absorption, and mass-analysis tube, a vacuum system, a light spectrometer, a mass spectrometer, a plasma-excitation source, a time-delay pulsing unit, and detection circuits for simultaneous light emission, absorption, and mass analysis. Results obtained from the use of this equipment are presented for the following areas: (1) time dependence of the electron density during the afterglow period of plasmas produced in hydrogen; (2) mobilities of such positive ions as those of helium, neon argon, and hydrogen; (3) recombination coefficients of molecular rare-gas ions; (4) destructive processes of metastable excited helium ions; (5) emission of light during the decay period of a plasma produced in both helium and neon; and (6) detection of hybrid molecular rare-gas ions. Also, the occurrence of processes of the type $He_2^+ + Ne \rightarrow Ne^+ + 2He$, as postulated by Oskam, was confirmed by mass spectrometry. I.v.L.

N64-18737* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FREQUENCY RANGES FOR EXISTENCE OF WAVES IN A COLD, COLLISIONLESS HYDROGEN PLASMA
Richard R. Woollett Washington, NASA, Apr. 1964 31 p refs
(NASA TN D-2273) OTS: $0.75

The dispersion relation of an electromagnetic wave propagating in a cold collisionless plasma at an arbitrary angle with the magnetic field was solved for an atomic hydrogen plasma. The results indicate that wave propagation is not possible for all values of frequency if the density, magnetic-field strength, and axial wavelength are held constant. Those regions of the frequency spectrum where wave propagation is possible are referred to as existence regions. Within these regions, bounded, cold collisionless plasmas exhibit natural modes of oscillation. Consequently, if experimental data fall in an existence region, the model of a cold collisionless plasma might be used to describe the phenomenon. The existence regions are determined for a range of magnetic fields from 10^2 to 10^5 gauss, a range of ion densities from 10^{10} to 10^{14} ions per cubic centimeter, and a range of selected axial wavelengths from 10 to 100 centimeters. The computations are compared with those resulting from an approximate dispersion relation that neglects the effects of electron inertia. Author

N64-18759 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING THE WARM-UP OF ELECTRONS OF MOVING PLASMA

V. M. Eleonskiy and Yu. Ya. Polyak 16 Jul. 1963 9 p refs Transl. into ENGLISH from Zhurnal Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 5, 1962 p 48–51
(FTD-MT-63-66/1+2; AD-434959)

The warmup of electrons in a flow of plasma moving across a magnetic field with a constant speed is examined. It is assumed that the warmup is stipulated by field $E_0 = 1/c\ U_0 \times B$. The relation of electron temperature to the temperature of deceleration of a plasma flow was studied for slightly and highly ionized plasma. For a model of constant length of free run, a comparison was made of the values of average energy, calculated according to accurate distribution function and in hydrodynamic approximation. Author

N64-18792 Ionosphären-Institut, Breisach (W. Germany)
DEVELOPMENT OF A LOW-WEIGHT MEASURING APPARATUS FOR ELECTRON DENSITIES IN A PLASMA [Final Report]
K. G. Jacobs 20 Nov. 1963 38 p refs
(Contract AF 61(052)-290)
(AFCRL-64-247; IIB-7; AD-434894)

Development and characteristics of an instrument that allows measurement of the electron density within the limits of about $5 \times 10^8 - 3 \times 10^{12} m^{-3}$ by impedance measurements on a plasma condenser with variable frequency are described. Characteristic frequencies, where certain resonances occur in the plasma, and the amplitude of those resonances are the test values of this method. The power level of the measuring frequency can be kept low, and, therefore, the perturbations of the surrounding plasma are negligible. Author

N64-18850 Microwave Associates, Inc., Burlington, Mass.
HIGH POWER BEAM-PLASMA AMPLIFIER Quarterly Progress Report No. 3, 15 Jun.–14 Sep. 1963
M. A. Allen, C. S. Biechler, P. Chorney, R. W. Gould, and H. S. Maddix 1963 81 p refs
(Contract DA-36-039-AMC-00076(E); ARPA Order 331-62; Proj. Defender)
(AD-426322)

Test results on the first test vehicle are given, showing 20-db net gain and 12-kw peak saturated power output. Design and construction of the second tube are discussed. Experimental results of the investigation of low-pressure PIG discharges are given. The computer program for the large signal theory is presented in detail, and some preliminary results are given. Author

N64-18851 Virginia U., Charlottesville School of Engineering and Applied Science
PROJECT SQUID Semi-Annual Progress Report, 1 Oct. 1963–31 Mar. 1964
1 Apr. 1964 82 p refs
(Contract Nonr-3623(00))
(AD-435879)

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N64-18853 Johns Hopkins U., Baltimore, Md.
INVESTIGATION OF TURBULENCE
Leslie S. G. Kovasznay *In* Va. U. Project Squid 1 Apr. 1964 p 7–10 refs (See N64-18851 11-24)

The free-stream edge of all turbulent flows (boundary layer, jet, wake) is sharp and not diffuse. This sharp-transition region, termed "superlayer," from nonturbulent to turbulent flow is being investigated. A simple model of the transition process, based on transport (or rate) equations, is being put on an analog computer in order to explore the consequences of different simple theoretical models. The crucial element in the model is the type of nonlinearity assumed, and a total of nine variations is under investigation. Experiments with the segmented (or Fowler-type) shock tube have continued. The large difference in signal level, which results when the signal is taken with or without a magnetic field, clearly indicates scrambling of the magnetic field by random fluctuation. I.v.L.

N64-18855 Aeronautical Research Associates of Princeton, Inc., N.J.
FUNDAMENTAL STUDY OF DYNAMICS OF GASES AND PLASMAS
Guido Sandri, Roger D. Sullivan, and Edward A. Frieman *In* Va. U. Project Squid 1 Apr. 1964 p 15–18 refs (See N64-18851 11-24)

The dynamics of gases and plasmas, pertinent to fusion and magnetohydrodynamic power generation and propulsion, are

discussed. Progress was obtained in three major problem areas of nonequilibrium statistical mechanics, namely, the theory of the master equation, the kinetic theory, and the theory of macroscopic or magnetohydrodynamic flows. New methods were developed for systematically deriving a hierarchy of irreversible equations for increasingly more averaged quantities. These new methods began with the time-reversible Liouville equation of statistical mechanics. The first of these derived equations is the master equation, which is satisfied by the momentum distribution of the gaseous particles. Also, a new, more general form of the master equation was derived that correctly includes the collective effects in a plasma. When the master equation is averaged over all of the particles in the gas, with the exception of one of the particles, the kinetic equation of the kinetic theory results. The theory of magnetohydrodynamic flows results from averaging the kinetic theory over the single-particle distribution function. The continuum flow, given by this theory, permits a ready understanding of the transport properties of gases. Single-component gases were emphasized in this research.

I.v.L.

N64-18856 Brown U., Providence, R.I.
RESEARCH ON THERMODYNAMIC AND TRANSPORT PROPERTIES OF GASES AT HIGH TEMPERATURES AND PRESSURES
J. Kestin, J. Ross, J. Carachi, R. Di Pippo, G. D. Flynn et al *In* Va. U. Project Squid 1 Apr. 1964 p 19–24 (See N64-18851 11-24)

The current program status includes the following: (1) It was found, in determining a precise value of the ratio of the viscosities of the isotopes of hydrogen, that the intermolecular force constants are different for HD and D_2 or H_2. Assuming that the values of σ are identical, it was found that $\epsilon_{H_2} < \epsilon_{D_2}$ by a small margin. (2) Assembling of the third torsional viscometer is progressing. Most of the effort is being directed towards designing the temperature-control system for the furnace. (3) A study of the effect of uncertainties in experimental viscosity values and available temperature range on the determination of the constants σ and ϵ in a Lennard–Jones potential showed that the uncertainty in the determination of ϵ is an order of magnitude inferior to that of σ. It was also found that reliable values of the two constants can be obtained only by a suitable combination of range and precision, and the exact relations have been put in analytic and graphical terms. (4) Completion of a number of details of construction and assembly is in progress on the capillary-flow viscometer for the measurement of the absolute viscosity of gases in the temperature range –150° to 0° C, and below 200 atms. (5) A model theory of the viscosity of dense gases has been worked out in detail and compares well with the few available experiments.

I.v.L.

N64-18857 Illinois U., Chicago
PROPERTIES OF TWO-PHASE FLOW – ELECTRIC PHENOMENA
S. L. Soo, J. A. Hultberg, G. J. Trezek, and R. C. Dimick *In* Va. U. Project Squid 1 Apr. 1964 p 25–29 refs (See N64-18851 11-24)

The interaction of solid particles with an ionized gas, their electrification by thermal and surface interaction, and the dynamics of a two-phase flow including charged solid particles were investigated. Measurements of oxides and metals in an arc-heated jet of argon show that, in the interaction of an ionized gas and solid particles, the solid particles may collect electrons by their capacitance, a process that is in competition with thermionic emission from the solid particles. The combination of low thermionic potential and high ionization potential tends to leave the particles negatively charged. The delaying nature of oxides on recombination processes explains the significance of an oxide in a rocket jet on its electron concentration. In the case of alumina, the effect of thermal electrification plays a significant part in slowing the recombination process. The radio-wave attenuation by a rocket jet, due to free electrons in the gaseous phase, is influenced by the material of the solid particles in the jet. It is indicated that the electric charge effect far overshadows the two-dimensional effect in a nozzle flow (two-phase flow).

I.v.L.

N64-18860 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
INVESTIGATION OF REACTION KINETICS IN HIGH-TEMPERATURE GASES
G. Markstein *In* Va. U. Project Squid 1 Apr. 1964 p 37–42 refs (See N64-18851 11-24)

This report is concerned with the kinetics and mechanisms in high-temperature gases. The specific systems under investigation are reactions of metal vapors with oxygen. The methods employed in the investigations are suitable adaptations of the dilute-diffusion-flame techniques. One of these methods is concerned with the chemical properties of flames. Preliminary observations seem to suggest that the probe current of a probe electrode, inserted into the flame zone of a low-pressure Mg-O_2-Ar diffusion flame, is in some way associated with the deposit growth on the electrode; however, they do not allow a close distinction between several possible causes of the current. Preliminary measurements were made of the rate of growth of surface deposits of Mg-O_2-Ar flames on a plane grid of parallel tungsten wires of 25μ diameter, spaced about 6 mm apart, inserted in the flames. The plane of the grid was orientated either vertically through the plane axis, or horizontally approximately at the plane of maximum flame diameter. The thickness of the MgO deposit grown on the wires after exposure to the flame gases for known times of the order of 20 to 30 min was measured by an optical comparator. These runs showed that the method is well suited for obtaining maps of growth rate in a plane intersecting the flame.

I.v.L.

N64-18865 Massachusetts Inst. of Tech., Cambridge
MAGNETOHYDRODYNAMICS OF PARTIALLY IONIZED GASES
James A. Fay, W. C. Moffatt, R. L. Leonard, and J. B. Workman *In* Va. U. Project Squid 1 Apr. 1964 p 67–71 refs (see N64-18851 11-24)

This report discusses basic theoretical and experimental investigations of the important physical phenomena arising in magnetohydrodynamic propulsion and power-generation machines. The theoretical investigations are centered on a study of the unsteady wave motion in the presence of electric and magnetic fields. The experimental investigations are focused on the utilization of combustion-driven shock tubes for the purpose of laboratory duplication of those conditions of gas velocity, temperature, density, and electrical conductivity that might prevail in an actual device.

I.v.L.

N64-18901 Princeton U., N.J. Gas Dynamics Lab.
THE LANGMUIR PROBE IN A COLLISIONLESS PLASMA
S. H. Lam Mar. 1964 71 p refs
(AF AFOSR Grant 112-63)
(Rept. 581; AFOSR-64-0353; AD-434842)

This paper presents an asymptotic analysis of the Langmuir probe problem in a quiescent, collisionless plasma in the limit of large body dimension to Debye-length ratio. The structures of the electric potential distribution about spheres and cylinders are analyzed and discussed in detail. It is shown that when the probe potential is smaller than approximately 1/2KT, where T is the undisturbed temperature of the repelled particles, there

exists no sheath adjacent to the solid surface. At large body potentials, for which a sheath is present, the electric potential distribution is given in terms of several universal functions. Master current–voltage characteristic diagrams are given that exhibit clearly the effects of all the pertinent parameters in the problem. An explicit trapped-ion criterion is presented. The general problem with an arbitrary body dimension to Debye-length ratio is qualitatively discussed. Author

N64-18924 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
A COMPUTER PROGRAM TO DETERMINE PLASMA DENSITY FROM EXPERIMENTAL HYDROGEN SPECTRAL LINE SHAPES
D. A. Mc Pherson and H. S. Porjes 23 Mar. 1964 24 p refs
(ATN-64(9233)-8; AD-435808)

This IBM 7090 program fits theoretical hydrogen line shapes to experimental line shapes in order to determine plasma density. The fitting process is discussed to illustrate the limitations of the program. Resolution of the optical system is included. Data input and output are considered in detail, and a specific computation by the program is presented. No familiarity with computers is required to use this program, although the aid of a programer would be useful to insure that the input data are in the correct format. Author

N64-18954* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ELECTROMAGNETIC WAVE PROPAGATION IN A COLD, COLLISIONLESS ATOMIC HYDROGEN PLASMA
Richard R. Woollett Washington, NASA, Apr. 1964 126 p refs
(NASA TN D-2071) OTS: $2.75

The characteristics of electromagnetic wave propagation in a cold, collisionless plasma immersed in a steady, uniform magnetic field are presented in dimensional units. Data for the "principal" waves are presented as curves of wave number, wavelength, phase velocity, and group velocity, as functions of frequency. Wave numbers for oblique propagation are presented for angles of 0.1°, 1°, 10°, 45°, 80°, 89°, and 89.9°, relative to the magnetic-field direction. The range of magnetic-field strengths covered by the plots is 10^2 to 10^5 gauss, and the range of electron densities is 10^{10} to 10^{15} ions per cubic centimeter. Cutoff and resonance frequencies are also plotted as functions of density and magnetic-field strength. Author

N64-18996 California U., Livermore. Lawrence Radiation Lab.
RADIATIVE TRANSITION PROBABILITIES IN HYDROGEN
John R. Hiskes and C. Bruce Tarter 15 Jan. 1964 219 p
(Contract W-7405-ENG-48)
(UCRL-7088, Rev. I) OTS: $3.00

The radiative transition probabilities in hydrogen have been calculated for all possible transitions through $n = 25$ in both spherical coordinates (field free case) and parabolic coordinates (Stark case). In spherical coordinates, the transition probabilities are a function only of n and l, while in parabolic coordinates they are generally functions of all three parabolic quantum numbers, n_1, n_2, and m. For $m > 0$, and to within an error of the order of 1%, the Stark transition probabilities are a function of n and m only. Tables listing the total transition probability for all states through $n = 25$ in both sets of coordinates, and the individual transition probabilities through $n = 10$ in the parabolic case, and through $n = 25$ in the spherical case, are given. The radiative lifetimes are presented graphically. The range of applicability of the transition probabilities is given. Author

N64-19048 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBLEMS OF MAGNETOHYDRODYNAMICS AND PLASMA DYNAMICS II [VOPROSY MAGNITNOY GIDRODINAMIKI I DINAMIKI PLAZMY II]
K. P. Stanyukovich et al 25 Feb. 1963 661 p refs Transl. into ENGLISH of papers presented to the 2d Conf. on Theoret. and Applied Magnetohydrodynamics, Riga, 27 Jun.–2 Jul. 1960 from Izd. Akad. Nauk. Latv. SSR, 1962 p 1–660
(FTD-TT-62-1301/1+2; AD-299679)

This collection of papers includes theoretical problems of magnetohydrodynamics and plasma physics, experimental problems of plasma physics, and applied magnetohydrodynamics. E.W.

N64-19066 General Electric Co., Syracuse, N.Y. Radio Guidance Operation
FEASIBILITY DEMONSTRATION OF A NEW PLASMA DIAGNOSTIC PROBE Final Report [1 Dec. 1962-30 Dec. 1963]
D. Kingsland 27 Mar. 1964 58 p refs
(Contract AF 19(628)-2378; ARPA Order 363)
(AFCRL-64-254; Rept. 64A025; AD-435677)

The purpose of this contract was to demonstrate the feasibility of utilizing the Thomson-scattered radiation of a ruby laser to determine electron temperature and density in a helium plasma. A thyratron tube was modified to create the plasma, and a spectrometer was used to observe the Doppler profile of the Thomson-scattered radiation. Langmuir-type probes built into the modified thyratron were used as an independent check on electron density and temperature. There was little correlation between the laser scattering and the check provided by the Langmuir probes. A precise determination of electron temperature was not realized using the laser scattering data. An electron density of approximately 10^{15}/cc was, however, deduced from the magnitude of the scattered energy. Opposed to this was a value, approximately 6×10^{12}/cc, derived from the Langmuir probe data. Theoretical effort supports the laser scattering data and negates the validity of the Langmuir probe data. Author

N64-19069 AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
SHOCK TUBE GAS DYNAMIC CHARTS. PART I: EQUILIBRIUM ARGON-FREE AIR FROM 3,000 TO 40,000° K
J. D. Laird and K. Heron 10 Apr. 1964 54 p refs
(RAD-TM-64-12)

This report contains charts for the equilibrium properties of argon-free air from 3,000° to 40,000° K for use in conjunction with shock-tube operation. The charts were obtained from a solution for arbitrary gas mixtures of the equations governing the flow properties for the incident, reflected, and standing waves and the stagnation point flow found in shock tubes. Author

N64-19083 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
THE APPLICATION OF THE FOCUSED FABRY-PEROT RESONATOR TO PLASMA DIAGNOSTICS
R. I. Primich and R. A. Hayami Aug. 1963 58 p refs
(TM63-210)

The use of a focused Fabry–Perot resonator at microwave frequencies for plasma diagnostics is discussed. It is shown theoretically that improvements in sensitivity in the measurements of the properties of transparent plasmas and dielectrics of two to three orders in magnitude can be expected. Losses have been neglected. It is indicated that, under certain circumstances, refractive index changes in the

gaseous environment may be significant. Included is a method of measuring these changes. The extension of these techniques to the optical part of the spectrum is discussed and shown to be promising. Experimental results that are presented, obtained with the use of a cavity at 70 Gc, appear to confirm the main predicted features. Author

N64-19104 Paris U., Orsay (France) Service de Physique des Plasmas
DYNAMICS OF NON-LINEAR PLASMA OSCILLATIONS Technical Note No. 3
G. Kalman and G. Toulouse (Ecole Normale Superieure) 15 Jun. 1963 32 p refs
(Contract AF 61(052)-613)
(TN-313; LP-26; ARL-63-182; AD-417562)

A consistent perturbation method for the calculation of nonlinear effects in plasma oscillations in a one-component system without a magnetic field is studied. The unperturbed state is that of a "cold" plasma, without thermal particle motion; particle-plasmon interaction appears through nonlinearity only. A diagram technique is worked out that facilitates the application of some field theoretic methods. The frequency shift due to nonlinearities (self-energy effect) is calculated in detail. Author

N64-19143 Elcon Lab., Inc., Peabody, Mass.
HIGH POWER MAGNETICALLY CONFINED PLASMA DUPLEXER First Quarterly Report, 31 May-31 Aug. 1963
Edwin Langberg and Wellesley Dodds [1963] 54 p
(Contract DA-36-039-AMC-02364(E); Proj. Defender)
(AD-426769)

The calculation of the effect of reduction of ambipolar diffusion across the magnetic field on heat dissipation and gas cleanup of a duplexer filled with Penning mixture of noble gases is performed. Magnetic confinement geometries of cylindrical, toroidal, mirror, and cusp shapes are discussed. The result of preliminary measurements on cylindrical confinement are presented. The experimental design based on the cusp confinement is described. Author

N64-19161 Stevens Inst. of Tech., Hoboken, N.J.
STUDY OF THE STABILITY OF HYDROMAGNETIC PLASMAS Final Report
Winston H. Bostick Nov. 1963 16 p refs
(Contract AF 19(604)-4086)
(SIT-P104(11/63); AFCRL-63-764; AD-429818)

A list is given of publications and reports based on work supported by this contract, and a summary of the material covered in these documents is presented. In addition, reprints of articles concerning interactions between a plasma and a two-dimensional magnetic dipole, the geomagnetic cavity in the presence of solar wind, and plasma flow around a three-dimensional dipole are included. E.W.

N64-19169 Stanford U., Stanford, Calif. Stanford Electronics Lab.
ON THE ONE-DIMENSIONAL PLASMA-CONDUCTIVITY KERNEL IN THE SPACE-FREQUENCY AND SPACE-TIME DOMAINS
D. R. Dobrott Aug. 1963 56 p refs
(Contract AT(04-3)-326)
(Rept. 0256-2; SEL-63-088)

A one-dimensional plasma-conductivity kernel in the space-frequency and space-time domains is investigated. The kernel is derived using three equilibrium velocity distributions, the first-degree and second-degree Cauchy and the Maxwellian. Numerical and asymptotic calculations are made for all cases. The kernels are alike for small values of the respective parameters, (sx/a) and (x/at), but dissimilar for large values. The second-degree Cauchy kernel more closely approximates the Maxwellian kernel than does the first-degree Cauchy kernel. The space-frequency kernels all have negative real parts for large values of (sx/a). Author

N64-19170 Boeing Scientific Research Labs., Seattle, Wash.
ON THE STABILITY OF MHD CHANNEL FLOW
F. D. Hains Mar. 1964 28 p refs
(Flight Sci. Lab. Rept. 88; D1-82-0331)

The stability equations are derived for MHD channel flow with aligned magnetic field, and are simplified in three limiting cases: (1) The interaction parameter N is very small. (2) The magnetic Reynolds number is very large. (3) The magnetic Reynolds number is very small. The shape of the stability diagram depends on the choice of nondimensional parameters used to describe the magnetic interaction. The shape of the stability curves are given for three choices for this parameter—N, N Re, and N/Re. For the last choice, the stability curves form closed loops. As N/Re is increased, these loops shrink and disappear. This information is used to show that the results of Stuart and Rossow, with closed and open curves, are in qualitative agreement. Author

N64-19196 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERACTION BETWEEN SMALL PERTURBATIONS WITH DISCONTINUITIES AND THE STABILITY OF SHOCK WAVES IN MAGNETOHYDRODYNAMICS
V. M. Kontorovich 14 May 1963 12 p refs Transl. into ENGLISH from the book "Voprosy Magnitnoy Gidrodinamiki Plazmy" Riga, Akad. Nauk Latviyskoy SSR, 1959 p 117–125 Previously issued as N63-83457
(FTD-TT-63-198/1+2+4; AD-407937)

A geometric method is proposed for plotting divergent (reflected and refracted) waves that occur in the case of interaction between small perturbations with discontinuities and the stability of shock waves in magnetohydrodynamics. Based on the results obtained, the problem of the resistance of shock waves to splitting, with respect to oblique perturbations, was examined. This geometric method can also be applied in simplified form to the interface of two media in a compressible fluid, and also to a tangential discontinuity. R.T.K.

N64-19205 Michigan U., Ann Arbor.
MICROWAVE PLASMA COMPONENTS STUDY
Andrejs Olte and E. K. Miller Griffiss AFB, N.Y., RADC, Mar. 1964 29 p refs
(Contract AF 30(602)-2605)
(RADC-TDR-64-92; AD-436642)

The development of a first-order theory for the transmission characteristics of a magnetoplasma resonance isolator employing the TM_{11} mode in a rectangular waveguide is continued, using a tensor permittivity plasma model. The results are compared with those obtained previously where an equivalent scalar permittivity was used. Effect of variation of the magnetostatic field over the plasma volume is investigated. Some previously obtained experimental data are compared with the theoretical results. Development of a hot-cathode discharge for use as a plasma package is described, and some preliminary measurements on electromagnetic-wave interaction with the discharge are given. Author

N64-19218 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STEADY-STATE CONDITIONS OF HIGH-TEMPERATURE PLASMA. A PINCH IN A LONGITUDINAL MAGNETIC FIELD

E. F. Tkalich and V. S. Tkalich 21 May 1963 18 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 32, no. 12, Dec. 1962 p 1418–1427

(FTD-TT-63-373/1+2+4; AD-414716)

Steady-state conditions of high-temperature plasma are studied in a kinetic approximation. The radial distribution of density, azimuthal current, and other macroscopic physical values in a pinch with longitudinal magnetic field are investigated. Author

N64-19282 Los Alamos Scientific Lab., N. Mex.

AN UNCONDITIONALLY STABLE IMPLICIT DIFFERENCE SCHEME FOR THE HYDRODYNAMICAL EQUATIONS

James Turner and Burton Wendroff 15 Apr. 1964 47 p refs

(Contract W-7405-ENG-36)

(LA-3007) OTS: $0.75

Two hydrodynamical problems are solved. The first involves a shock wave, a contact discontinuity, and a rarefaction wave using an unconditionally stable finite-difference scheme. The Courant condition is satisfied everywhere except in one zone behind the shock, where it is violated by factors of 10 and 100. The nonlinear difference equations are solved by Newton's method. The total number of Newton iterations to arrive at a particular time is independent of the degree to which the normal stability condition is violated in the one zone. The second problem involves two rarefaction waves moving in opposite directions. One wave moves in a region where the Courant condition is violated by a factor of approximately two. The other wave moves in a region where the Courant condition is satisfied. Numerical results are compared with the analytical solution. Author

N64-19285 New York U., N.Y. Courant Inst. of Mathematical Sciences

ASYMPTOTIC DESCRIPTION OF THE CUSPS OF A HYDROMAGNETIC FIGURE OF EQUILIBRIUM

Robert E. Dowd 1 Feb. 1964 77 p refs

(Contract AT(30-1)-1480)

(MF-37; NYO-10435)

Discussed is controlled fusion research involving an attempt to confine a perfectly conducting plasma in a strong magnetic field. Of several confinement schemes proposed, the cusped geometry model offers promise of stability in exchange for some leakage through the cusps. Asymptotic formulas are provided for the cusps of the simplest cusped geometry, which is a spindle-shaped figure consisting of two tapered circular cones set back to back. The spindle is supposed to contain a plasma, a fluid at rest, and therefore at constant pressure. An external vacuum magnetic field due to a quadrupole at infinity balances the fluid pressure. The problem of finding the shape of the interface between the fluid and the vacuum is stated as a differential equation with two boundary conditions. Garabedian, by analytic continuation into the four-dimensional space of two complex variables, restates this problem as an integral equation in terms of an analytic function g(z). In the real plane, the trace of the interface is given by $\bar{z} = g(z)$. Author

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-18563 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.

SOLID STATE IMAGE INTENSIFERS, PHASE II. DEVELOPMENT OF AN INTERNAL TRAINER OPTICAL SYSTEM IMAGE INTENSIFIERS Final Report

Zoltan Szepesi and William A. Thornton Nov. 1963 178 p refs

(Contract N61339-562; Proj. LIT)

(NAVTRADEVCEN 562-1; AD-431545)

Three different and new construction methods were developed in building the low-resolution image-intensifier panel: (1) Fotoform substrate construction; (2) grooved-glass construction with wire electrodes; and (3) sandwich construction. The sandwich construction, after the difficulties had been solved, proved to be a superior solution because of its simplicity and inherent higher resolution. Image-intensifier panels have been built in sizes up to 6 in. × 6 in., with maximum standard luminous gains (2,870° K light source) of 100 ft-L per ft-c, with maximum output brightness of 30 ft-L, and with resolution higher than 100 lines per inch. Regarding the high-resolution image intensifer, a major effort has been spent in developing an evaporated EL film. Working image intensifiers in this construction have not been built yet. Author

N64-18579 Corning Glass Works, N.Y.

GLASS LASER RESEARCH Semiannual Technical Report, Jul.-Dec. 1963

T. C. Mac Avoy, M. L. Charters, N. F. Borrelli, M. E. Vance D. Weinberg et al 30 Jan. 1964 29 p refs

(Contract Nonr-3833(00); Proj. Defender)

(AD-431753)

The properties of a soda-lime-silicate laser glass, known as Code 0580 glass, are reported; they include spectral properties, glass properties, composition, laser threshold, and impurity analysis. The variation of the optical path through a laser rod during flash illumination has been observed. Factors important in understanding this effect are discussed, and experimental measurements of them are described. Laser damage experiments on 17 different kinds of glass, selected for their unique properties, have been analyzed. Four possible mechanisms have been advanced. An analysis has shown that long lifetimes and high neodymium concentrations are the most important parameters for high-energy storage. A new technique has been developed to measure thresholds using constant spectral and temporal pump light. Author

N64-18590 Northwestern U., Evanston, Ill. Technological Inst.

INVESTIGATION OF THE SURFACE OPTICAL PROPERTIES OF OXIDES AS A FUNCTION OF COMPOSITION Technical Documentary Report, Dec. 1958–Jun. 1963

R. Frerichs and D. H. Whitmore Wright-Patterson AFB, Ohio, Res. and Technol. Div., Feb. 1964 202 p refs

(Contract AF 33(616)-6194)

(RTD-TDR-63-4196; AD-434372)

Two main areas of investigation were undertaken: (1) The thermodynamic phase of the program resulted in an evaluation of the oxygen partial pressure–temperature relations in the case of the metal oxide mixtures studied and oxygen pressure–composition–temperature relations in the case of the nonstoichiometric oxides investigated. These latter data provide a means of distinguishing the predominant point defect present in the nonstoichiometric α-Nb_2O_5 and TiO_2. (2) The thermoelectric power and the electrical conductivity of nonstoichiometric TiO_2 were studied, both as a function of temperature and oxygen pressure. From this phase of the investigation, it was concluded that TiO_2 becomes n-type upon slight reduction, with conduction believed to result from the excitation of

electrons from donor centers into a narrow d-conduction band. Doping of single crystals of oxides like MnO and CoO by hydrogen ion bombardment resulted in significant electronic property changes. Author

N64-18592 General Electric Co., Syracuse, N.Y. Electronics Lab.
FAILURE MECHANISMS AT SURFACES AND INTERFACES Second Interim Technical Documentary Report, 1 Oct. 1963-1 Jan. 1964
K. K. Reinhartz, V. A. Russell, D. L. Stockman, W. J. vander Grinten, W. L. Willis Griffiss AFB, N.Y., RADC, Mar. 1964 75 p refs
(Contract AF 30(602)-3085)
(R63ELS-75; RADC-TDR-64-35; AD-435469)

Analysis of the aging effects of thin-film field-effect devices, exposed to various temperatures in a dry argon atmosphere, with special emphasis on the transconductance g_m and the threshold voltage V_o, has led to the following findings: (1) At 30° C, both g_m and V_o are essentially invariant for more than 150 days. (2) At 76° to 121° C, g_m remains constant to within 10% to 15%, and V_o reaches a new equilibrium value after 10 days at 76° C or 3 days at 121° C. (3) The failure mechanism of (2) has been tentatively attributed to the desorption of water from the CdS-SiO interfacial region. "Demountable" thin-film field-effect devices have been developed for the rapid investigation of different types of dielectrics. Author

N64-18593 University Coll., Cardiff (Gt. Brit.)
AUGER EFFECTS INVOLVING RECOMBINATION CENTRES Technical Note No. 2
P. T. Landsberg, D. A. Evans, and C. Rhys-Roberts 13 Nov. 1963 6 p refs
(Contract AF 61(052)-664)
(AFCRL-63-946; AD-434593)

The concentration dependence of the lifetime of minority carriers in copper-diffused germanium is explained quantitatively. The fit yields an Auger effect mass-action constant that is shown to be in order-of-magnitude agreement with theory. Author

N64-18598 Lion Research Corp., Cambridge, Mass.
INVESTIGATION IN THE FIELD OF IMAGE INTENSIFICATION Final Report
Kurt S. Lion and G. F. Vanderschmidt Bedford, Mass. AFCRL, 31 Jan. 1964 69 p refs
(Contract AF 19(604)-5704)
(AFCRL-64-133; AD-435548)

The object of this study is an investigation of a solid-state image intensifier consisting of a photoconductive layer and a photographic emulsion in an electric field. An incident radiation pattern produces a local conductivity of the photoconductive layer and causes a current pattern and a corresponding blackening in the photographic emulsion. Intensification in excess of 10^3 was obtained at wavelengths between 800 and 850 mμ. The resolution is of the order of 100 to 300 μ. The intensification can be further improved by the use of thin layers of d.c.-excited electroluminescent layers. The investigation shows that several physical effects contribute to the blackening of the emulsion. Author

N64-18604 HP Associates Palo Alto, Calif.
INVESTIGATION OF HOT ELECTRON EMITTER Scientific Report No. 6, 1 Sep. 1963-31 Dec. 1963
R. W. Soshea et al [1963] 43 p refs
(Contract AF 19(628)-1637)
(AFCRL-64-134; AD-433894)

A summary of the work on CdS is presented, and it is concluded that resistivity of the evaporated films does not depend on the controlled evaporation parameters. It is observed that gold substrates are destroyed by the evaporation of CdS onto a 300° C substrate whereas platinum substrates are not. The evaporation of CdS has been dropped in favor of CdSe, which appears to be a more reproducible system. The range of 0.95 ev hot electrons in gold films has been photoelectrically determined to be 330 ±30 A. This value is obtained with gold films on chemically prepared silicon as well as on samples cleaved in an evaporating gold stream at $\sim 5 \times 10^{-9}$ torr. A discussion of the range measurements is presented, and this value of range is compared to that measured by other investigators. Author

N64-18638 National Lead Co. of Ohio, Cincinnati Technical Div.
THE INVERSION OF POLE FIGURES FOR MATERIALS HAVING ORTHORHOMBIC SYMMETRY
Peter R. Morris (M.S. Thesis—U. of Cincinnati) 10 Apr. 1964 59 p refs
(Contract AT(30-1)-1156)
(NLCO-903) OTS: $1.50

A method for inverting pole figures for materials having orthorhombic symmetry is described. The method entails expansion of the axis distribution in a series of spherical surface harmonics of appropriate symmetry, even in x_1, x_2, x_3. Truncation of the series at order n = 2, 4, 6, . . ., 2m, where m is a nonnegative integer, gives rise to n/2 systems of 2, 3, n/2 + 1 simultaneous linear equations in a like number of variables, requiring a minimum of n/2 + 1 pole figures for solution. A method for evaluating the goodness of fit of the inversion process is suggested. Author

N64-18655 Battelle Memorial Inst., Columbus, Ohio
RESEARCH, STUDIES, AND INVESTIGATIONS OF MATERIALS SENSITIVE TO RADIATION IN THE 8 TO 14-MICRON REGION OF THE INFRARED SPECTRUM Final Report, 1 Oct. 1962-30 Nov. 1963
C. M. Chapman, J. W. Moody, R. C. Himes, and T. S. Shilliday 30 Nov. 1963 49 p refs
(Contract DA-44-009-ENG-4461)
(AD-429997)

Periodic Group IIB-VIA compounds and alloys were investigated as possible materials for an infrared detector sensitive to radiation in the 8 to 14-micron region of the spectrum. Results indicate that : (1) The HgTe, HgSe, HgTe, and CdTe are not suitable materials for the detector. (2) The most suitable cells have photoconductive response maxima at 9.9 and at 10.8 microns when cooled to 77° K. Their compositions are approximately 78 HgTe-22CdTe (mole percent). An estimate of the spectral density of each cell is D_λ^* (9.9, 900, 1) = 10^9 cm(cps)$^{1/2}$/watt and D_λ^* (10.8, 900, 1) = 10^9 cm(cps)$^{1/2}$/watt. The effective time constants are about 50 microseconds. Also, properties of the HgTe-CdTe alloy applicable to a detector of the infrared radiation in the 8- to 14-micron-wavelength region, suggestions for the improvement of existing detectors, and recommendations for further work on the alloy system leading to the preparation of optimum HgTe-CdTe detectors are summarized. I.v.L.

N64-18657 Massachusetts Inst. of Tech., Cambridge
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report

J. C. Slater, M. P. Barnett, G. F. Koster, J. H. Wood et al
15 Jan. 1964 106 p refs
(Contract Nonr-1841(34); NSF Grant 24908 NSF Grant 10821; AF 19(628)-356)
(Rept. 51; AD-429325)

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7. THEORY OF SPIN-ORBIT COUPLING IN ATOMS. III M. Blume, A. J. Freeman, and R. E. Watson p 82–101 refs

N64-18658 Massachusetts Inst. of Tech., Cambridge
ENERGY BAND CALCULATIONS BY THE AUGMENTED PLANE WAVE METHOD
J. C. Slater *In its* Solid-State and Mol. Theory Group 15 Jan. 1964 p 14–40 refs (See N64-18657 11-25)

The augmented plane-wave method was investigated. Results indicate that it shares with the Green-function method the distinction of being the most accurate procedure available for calculating energy bands in the type of periodic potential found in a solid. The errors involved in the particular type of potential assumed, namely one that is spherically symmetrical in spheres surrounding each atom and constant between, are small. R.T.K.

N64-18659 Massachusetts Inst. of Tech., Cambridge
SYMMETRY PROPERTIES IN THE SPACE GROUP O_h^3 (Pm3n)
L. F. Mattheiss *In its* Solid-State and Mol. Theory Group 15 Jan. 1964 p 54–68 refs (See N64-18657 11-25)

The irreducible representations for the space group O_h^3 were obtained. The work was carried through using, to a large extent, the notation and conventions established by Slater. The present work is compared with that done by Gorzkowski, who carried through his analysis in terms of space group operators that multiply according to the Seitz convention, which differs from the method used by Slater. R.T.K.

N64-18660 Massachusetts Inst. of Tech., Cambridge
CORRECTION AND EXTENSION OF EVJEN'S METHOD FOR EVALUATING CRYSTAL POTENTIALS BY MEANS OF LATTICE SUMS
J. P. Dahl *In its* Solid-State and Mol. Theory Group 15 Jan. 1964 p 69–81 refs (See N64-18657 11-25)

Evjen's sum is set up for a general lattice. By solving Poisson's equation, with well-defined boundary conditions, it is shown how to obtain the proper constant of integration and correction to the Evjen potential. The method is illustrated by using as examples NaCl structure and CsCl structure. R.T.K.

N64-18666 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THERMAL AND OPTICAL EXTERNAL QUENCHING OF PHOTOLUMINESCENCE KJ-TI
G. G. Liydya and I. V. Yaek 17 Jul. 1963 15 p refs Transl. into ENGLISH from Tr. AN Est. SSR, Inst. Fiz. i Astron. (Tallinn), no. 14, 1961 p 236–246
(FTD-MT-63-29/1+2; AD-434946)

Discussion is given of the thermal and optical quenching mechanisms of KI-Tl photoluminescence and the internal and external excitation processes involved in quenching of luminating crystals. The action of the alkali halides (excitons) in a system of inorganic phosphors (activators) is examined at two stages to measure the emission intensity ratio. The excitation at the first stage (the ground state) is compared to the excitation of the zone-to-zone transition of successively higher energy levels (the second stage). Measurements are taken of the influence of heating and optical brightening by the light from the F-band region of the absorption spectrum. A.L.B.

N64-18668 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STRUCTURE OF SPECTRUM OF NATURAL RECOMBINATION OF GALLIUM ARSENIDE
D. N. Nasledov, A. A. Rogachev et al 16 Jul. 1963 7 p refs Transl. into ENGLISH from Fiz. Tverd. Tela (Leningrad), v. 4, no. 11, 1962 p 3346–3348
(FTD-MT-63-34/1+2; AD-434943)

The spectral distribution of natural recombination radiation of gallium arsenide at various temperatures in the range from 77° to 300° K is presented. At room temperatures, the spectra of natural recombination radiation were found to have two maxima. The results of this investigation are in agreement with the results of Nasledov et al. R.T.K.

N64-18669 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF DIFFUSION OF SILICON IN CERTAIN TRANSITIONAL METALS
G. V. Samaonov, M. S. Kovalchenko, and T. S. Verkhoglyadova 12 Jul. 1963 11 p refs Transl. into ENGLISH from Russian Periodical, Inzhenerno-Fiz. Zhur. (Minsk), no. 3, 1959 p 62–67
(FTD-MT-63-39/1+2; AD-434940)

The paper sets forth results of an investigation of the diffusion of silicon in Ti, Ta, Fe, and Mo. A formula is given that describes the relative change of weight of samples with a temperature T and time τ of saturation. The electrical resistance and critical tension of silicic layers have been measured with an instrument described in paper. Results of measurements of thickness of layers, phase layers, and microhardness, the magnitude of the critical tension, the energy of activation Q, and the constant formulas for change of the coefficient of diffusion D with temperature are shown in tables. Author

N64-18690 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Tech. Div.
DIAGRAM OF FUSIBILITY OF THE SYSTEM NI-CR-NiAl
I. I. Kornilov and R. S. Mints 21 Nov. 1963 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, (Moscow) v. 94, no. 6, 1954 p 1085–1088
(FTD-MT-63-174; AD-434974)

Thermal analysis and microstructural methods were used to investigate the fusibility diagram of the Ni–Cr–NiAl system. Construction of the liquidus curve showed the following: (1) The liquidus curve of the sections parallel to the Ni–Al side to

40 wt % Cr consists of two descending branches, crossed at one point. The temperature at the intersection decreases with increasing Cr content. (2) At a content of 45, 50, and 55 wt % Cr, the liquidus curve has only one branch, lifting from the Ni–Cr side to the Cr–NiAl side. (3) The liquidus curve of sections with a constant content of 10, 20, and 30 wt % Ni consists of two branches whose intersection point decreases with increasing nickel content. Orthogonal projection of the liquidus curve of the sections studied on a triangle of compositions shows that the surface of the liquidus curve for the Ni–Cr–NiAl system contains four fields of primary crystallization: α-solid state of Ni and Al with a Cr base; β-solid state of Ni and Cr with a NiAl base; γ-solid state of Cr and Al with a Ni base; and γ'-solid state of Cr, Ni, and Al with a Ni_3Al base. M.P.G.

N64-18692 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TELLURIDES OF LANTHANUM
E. I. Yarembash, E. S. Vigileva, A. A. Eliseev, and L. I. Antonova 29 Nov. 1963 6 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 8, no. 6, 1963 p 1542–1543
(FTD-MT-63-249; AD-434972)

The conditions under which tellurides of lanthanum can be formed were investigated. The phase composition of products of the direct interaction of lanthanum with tellurium were also studied. R.T.K.

N64-18750 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PRESSURE DURING EVAPORATION OF A SUBSTANCE IN A BEAM OF RADIATION
G. A. Askaryan and E. M. Moroz 17 Jul. 1963 6 p Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz., v. 43, no. 6, 1962 p 2319–2320
(FTD-MT-63-35/1+2; AD-434942)

Estimates were made to show that the output pressure during evaporation can exceed the beam pressure of the focused beam of a ruby laser. Applications of this effect that are discussed are acceleration of particles of a substance in a laser beam, and generation of ultrasound and hypersound. R.T.K.

N64-18752 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF INFLUENCE OF REFRACTORY ELEMENTS ON THE SELF-DIFFUSION OF IRON WITH THE HELP OF RADIOACTIVE ISOTOPES
S. Z. Bolshteyn et al 12 Jul. 1963 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, (Moscow), no. 12, 1955 p 18–27
(FTD-MT-63-40/1+2; AD-434939)

The relation of the coefficient of self-diffusion D of iron in iron–nickel, molybdenum, niobium, titanium, and vanadium was determined. The addition of nickel and vanadium leads to an increase of the diffusion mobility of iron atoms, to a decrease of the preexponential multiplier D_0, and to a decrease of the energy of self-diffusion. The addition of molybdenum, niobium, and titanium leads to a decrease of the diffusion mobility of iron, to an increase of the preexponential multiplier, and to a strong increase of the heat of diffusion. From the data it can be assumed that the introduction of molybdenum, niobium, and titanium in iron leads to an increase of the durability of the interatomic bond. Author

N64-18753 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
OPTICAL QUENCHING AND STIMULATION OF CERTAIN ZnS PHOSPHORS
K.-S. K. Rebane and F. A. Savikhin 12 Jul. 1963 6 p refs Transl. into ENGLISH from Tr. Akad. Nauk Est. SSR, Inst. Fiz. i Astron. (Tallinn), no. 14, 1961 p 276–280
(FTD-MT-63-41/1+2; AD-434970)

The optical quenching and stimulation of the following ZnS phosphor-activator combinations were investigated: ZnS-Zn, ZnS-Ag, and ZnS-Cu. Excitation was produced by a PRK-4 lamp through two UFS-2 light filters. Blue and green luminescence bands of the phosphors were emanated with the aid of corresponding combinations of light filters. A 400-w incandescent lamp was the stimulating light source. The glow of the phosphors was registered by the photoelectric method. Results indicate that: (1) The spectrum of stimulation of optical quenching, in general, does not coincide with the spectrum of stimulation of optical flash for one and the same band of glow. (2) The spectrum of stimulation of flash has apparently two bands in the shortwave region. One band lies approximately in the region of green-band optically quenching, near 700 $m\mu$ to 800 $m\mu$. The other band lies in a region of shorter wavelengths than was used in the experiment. (3) The long-wave band of flash stimulation (near 1350 $m\mu$), for the green and blue bands of the glow of ZnS-Cu (10^{-5}g/g), is located in a spectral region usually occupied by the long-wave band of the stimulation of quenching of the green glow of ZnS-Cu phosphors. A reduction in the Cu concentration in the phosphor results in the absence of a long-wave maximum in the spectrum of flash stimulation for the blue band of glow. I.v.L.

N64-18758 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEW METHODS OF APPRAISAL OF SURFACE PURITY
A. L. Chestnov 15 Jul. 1963 12 p Transl. into ENGLISH from the book "Avtomatizatsiya Protsessov Mashinostroyeniya, Vol. I: Obshchiye Voprosy i Sredstva Avtomatizatsii" Moscow, Izd. AN SSSR, 1962 p 201–206
(FTD-MT-63-63/1+2; AD-434962)

A method is described for estimating the roughness of a surface. The relationship between the height of surface irregularities to the average arithmetical deviation for various forms of processing and various methods of determination of the height of the irregularities was investigated. It was established that in the measurement of irregularities along the five highest and five lowest points, the ratio of the height of irregularities to the average arithmetical deviation changes from 5, for purely processed surfaces, to 3.9 for coarsely processed surfaces. R.T.K.

N64-18777 Princeton U., N.J. Frick Chemical Lab.
THE FREQUENCY CHECK, AN EXTENSION OF THE VECTOR VERIFICATION METHOD Technical Report No. 7
B. T. Gorres and R. A. Jacobson 22 Nov. 1963 73 p refs (Contract DA-ARO(D)-31-124-G265; NSF Grant GP79) (AD-434155)

The frequency check, utilizing three-dimensional superpositions of the Patterson and vector verification maps, assigns relative values to positions in electron-density space which are consistent with both the Patterson function and the space group symmetry of the crystal system. These relative values, which represent the extent of peak coincidence between a Patterson and electron density function, facilitate the choice of the first tentative atom position, a decisive factor in the success of the vector verification procedure. Employing a bivalued Patterson map, each three-dimensional superposition resulting in a relative value requires 1 to 5 sec on a large solid-state computer. Tentative vector calculations are also discussed. Author

N64-18793 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
RECENT ADVANCES IN MICROWAVE PHONON GENERATION AND DETECTION AND THEIR APPLICATION TO THE STUDY OF PHONON-PHONON INTERACTIONS IN QUARTZ Scientific Report No. 5
J. de Klerk 2 Jan. 1964 65 p refs
(Contract AF 19(604)-8826)
(AFCRL-64-58; AD-434757)

The design procedure and considerations for a tunable resonant coaxial microwave cavity are discussed. The design of a practical cavity for use between 1 and 8 kmc/sec is given. A technique is outlined for producing exponentially decaying echo envelopes. A method is given for accurately measuring small changes in low attenuation rates. Measurements made in quartz at low temperatures and at 1,000 mc/sec are described. Author

N64-18878 Oxford U. (Gt. Brit.)
INFRA-RED ABSORPTION OF HYDROGEN AND DEUTERIUM IONS IN CALCIUM FLUORIDE Scientific Report No. 4
W. Hayes, G. D. Jones, R. J. Elliott, and C. T. Sennett 30 Jan. 1964 9 p refs
(Contract AF 61(052)-677)
(AFCRL-64-284; AD-435616)

An investigation has been made of the localized vibrations of hydrogen and deuterium ions present as impurities situated on the fluorine sites in calcium fluoride. Author

N64-18904 General Electric Co., Schenectady, N.Y. Research Lab.
SEMICONDUCTOR DEVICE CONCEPTS Scientific Report No. 6
31 Jan. 1964 55 p refs
(Contract AF 19(628)-329)
(AFCRL-64-135; AD-433975)

Halogen transport synthesis of $GaAs_xP_{1-x}$ has been studied further, using a rotating tube vertical furnace. Laser quality material has been produced using Te and Si as the donor impurities, and the homogeneity has been improved. Measurements of composition, carrier concentration, and optical transparency are reported. A "red–black" effect has been discovered that has been found to be helpful in selecting laser quality regions from $GaAs_{1-x}P_x$ ingots having compositions near the direct–indirect limit. The possibility of achieving coherent light emission from junctions in wide band gap II to VI compounds has been examined. A preliminary evaluation of a heterojunction laser structure is described. A systematic study of the introduction and behavior of acceptor impurities in CdS has been started. Author

N64-18931 Minnesota U., Minneapolis
RESEARCH ON PHOTOEMISSION Final Report, 16 Dec. 1961-15 Dec. 1962
W. T. Peria, ed. Wright-Patterson AFB, Ohio, ASD, Mar. 1963 114 p refs
(Contract AF 33(657)-8041)
(ASD-TDR-63-340; AD-405730)

Various studies of sodium-covered surfaces are described. Electron diffraction studies show that the surface structure of the Ge crystal is changed in the presence of the adsorbed Na and a detailed description of the effect of temperature on the structure is given. A study of the surface properties of Ge, using field-emission microscopy, was initiated as an extension of the studies of Na overlayers on Ge. A system for the production and investigation of photoemissive yield dependence on thickness, temperature, and composition of Na_3Sb films is described. Author

N64-18952* Radio Corp. of America, Camden, N.J.
PROTON DAMAGE IN SEMICONDUCTOR DEVICES Final Report, 16 Apr.-1Nov. 1962
D. M. Arnold, J. A. Baicker, H. Flicker, D. A. Gandolfo, J. R. Parker et al Washington, NASA, Apr. 1964 73 p refs
(NASA Contract NAS1-1654)
(NASA CR-40) OTS: $2.00

The objective of the present study is to interpret observed changes in transistor electrical characteristics in terms of fundamental changes in the semiconductor crystal structure and, in so doing, to predict the effects of proton bombardment. Emphasis is placed on lattice displacements, but transmutations and ionization are also considered. Proton and neutron displacement production rates are calculated. These are used in conjunction with neutron irradiation data and an assumed similarity of defect clusters to determine the effects of protons on transistors. Reasonable agreement with experiment is obtained. The expected lives of transistors in satellites orbiting in the inner Van Allen belt are given. Author

N64-18960* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
SURFACE TOPOGRAPHY OF SINGLE CRYSTALS OF FACE-CENTERED-CUBIC, BODY-CENTERED-CUBIC, SODIUM CHLORIDE, DIAMOND, AND ZINC-BLENDE STRUCTURES
Robert J. Bacigalupi Washington, NASA, Apr. 1964 77 p
(NASA TN D-2275) OTS: $2.00

Atom locations on planes of ideal crystals in face-centered-cubic, body-centered-cubic, sodium chloride, diamond, and zinc-blende structures were obtained on an IBM 7090 computer by quantizing the vector equation of a plane whose orientation is described by the Miller indices. The plotting of solutions results in an orthographic projection of the respective surface plane and several parallel planes immediately adjacent. Surface density, interplanar distance, number of nearest and next nearest neighbors and their locations, nearest surface neighbor distance, and displacement vector are calculated from the atom positions. Author

N64-18984 California U., Berkeley. Lawrence Radiation Lab.
STACKING FAULT ENERGY, ORDERING AND TRANSGRANULAR STRESS CORROSION CRACKING IN Fe-Cr-Ni ALLOYS
Walter Ray Roser (M.S. Thesis) Aug. 1963 47 p refs
(Contract W-7405-ENG-48)
(UCRL-10890) OTS: $1.00

In this investigation, the electron microscope has been used to measure the stacking fault energy of several iron–chromium–nickel alloys and to determine the dislocation structure after plastic deformation. It is found that additions of nickel increase the apparent stacking fault energy, and niobium in solid solution decreases the apparent stacking fault energy. Dislocations are found to remain coplanar even though from the stacking fault energy consideration, they would be expected to cross-slip and form tangles. The fact that coplanar dislocation arrays are observed does not necessarily predict that transgranular stress corrosion cracking will occur. Author

N64-19018 Los Alamos Scientific Lab., N. Mex.
AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. II. PROCESSING COLLECTED INTENSITY DATA

Allen C. Larson, Don T. Cromer, and R. B. Roof, Jr. 17 Apr. 1964 63 p refs
(Contract W-7405-ENG-36)
(LA-3043) OTS: $1.50

The procedures employed and the computer program used for the processing of intensity data collected on a single-crystal orienter are described. Processing includes the correction of the data for Lorentz polarization, absorption, background, and crystal-shape effects and yields a nonscaled set of relative F^2. Author

N64-19102 National Cash Register Co., Dayton, Ohio Research Div.
RESEARCH AND INVESTIGATION OF CATHODOLUMINESCENT PHOSPHOR FILMS PREPARED BY SOLUTION SPRAYING Technical Documentary Report, 1 Jun. 1963-31 Aug. 1963
M. S. Hall, J. W. Gilliland, Jr., and E. Reinmuller Wright-Patterson AFB, Ohio, AF Avionics Lab., Mar. 1964 82 p refs
(Contract AF 33(657)-8985)
(AL-TDR-64-15; AD-436109)

The objective of this project was to determine the capabilities and necessary compromises in preparing cathodoluminescent films by a chemical solution spray process. This spray process is capable of forming cathodoluminescent films in situ on substrates that can withstand a spray temperature of 300° C and a heat treatment temperature of 600° C. Desired dopants may be incorporated by adding them to the spray solution. The cathodoluminescent film compositions investigated were: $CdWO_4$, $CdWO_4$:Sm, $CdWO_4$:Ce, $ZnWO_4$, Zn_2SiO_4:Mn, CdS:Ag, ZnS:Ag, and ZnCdS:Ag. Properties of these films were evaluated by X-ray diffraction analysis, by photoluminescent and cathodoluminescent brightness and spectral emission, and by the thermoluminescent "glow-curve" studies. Author

N64-19122 Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Honeywell Research Center
THINFILM IMAGE CONVERTER Third Interim Technical Progress Report, 24 Oct. 1963-23 Jan. 1964
Paul W. Kruse, Fred C. Pribble, Richard G. Schulze, and Valdis Sneberg 20 Feb. 1964 66 p refs
(Contract DA-44-009-AMC-168(T))
(AD-435788)

The performance of an elemental thin-film image converter has been simulated by a model consisting of a pnp Ge phototransistor in electrical series with a GaAs electroluminescent diode. Under the most favorable operating conditions, the radiant emittance of the diode is two orders of magnitude less than the irradiance of the phototransistor. The reasons for the attenuation, and potential improvements, are discussed. A literature survey of the optical properties of GaP is presented. The close-spaced vapor transport method for preparing epitaxial layers of GaAs on Ge is described. Author

N64-19124 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
SPIN WAVE ANISOTROPY IN PARALLEL PUMPING EXPERIMENTS ON YIG
James C. Sethares, Marden H. Seavey, Jr., and Martin R. Stiglitz Jan. 1964 69 p refs
(AFCRL-64-14; AD-435540)

A theoretical and experimental investigation of magnetic anisotropy effects on spin-wave excitation in parallel pumping experiments has been conducted. The experiments were performed at X-band frequencies on single-crystal yttrium iron garnet. Anisotropy is introduced into the framework of existing theory. The spin-wave dispersion relation and instability thresholds for pumping in a [110] crystallographic direction are derived. A number of experimental "butterfly" curves for various temperatures, crystallographic orientations, and geometries are obtained and compared with the theoretical predictions. A new effect, experimentally observable as an "extra corner" on the butterfly curves (separate from the phonon peaks), is shown to be directly related to the splitting of the top of the spin wave band that is produced by anisotropy. Author

N64-19145 Ohio State U. Research Foundation, Columbus
STUDY OF SEMICONDUCTOR SOLIDS USED AS PHOTOCATALYSTS IN THE FORMATION OF ENDOTHERMIC COMPOUNDS Final Report
Jack G. Calvert Sep. 1963 80 p refs
(Contract AF 19(604)-6644)
(AFCRL-64-120; AD-434789)

A study has been made of the physical properties of a series of CdS single crystals. Through gas adsorption, X-ray, ultraviolet, infrared, electron spin resonance, and electrical measurements the surface area, lattice spacing, absorption spectra, Hall effect, and conductivity of the single crystals have been determined. Samples of the same materials were ground to a powder, and the quantum yields of photosensitization of H_2O_2 and $CdSO_4$ formation have been determined. A correlation has been noted between the steady state $[H_2O_2]$ reached on exposure to a fixed intensity of 3660 A light and the conductivity of the crystals; the higher the conductivity, the lower the $[H_2O_2]$ at the steady state. The quantum efficiency of $CdSO_4$ formation appears to be decreased, the higher the impurity level in the crystal. Author

N64-19181 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TO DETERMINE THE ENERGY OF FORMATION OF VACANCIES IN SILVER
O. M. Ovcharenko 28 Feb. 1963 6 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 6, no. 1, 1961 p 139-140
(FTD-TT-63-124/1+2+; AD-400505)

An attempt was made to obtain data on the energy of formation and the energy of activation in dislocation of vacancies in silver. The experiments on quenching silver in open air showed that an increase in electroresistivity originates not only as a result of fixing the vacancies during the quenching but also as a result of detaining (delaying) the atoms by oxygen, which is dissolved in the silver when it is heated to high temperatures. Experiments were made on the quenching of silver in open air and in helium with various oxygen admixture concentrations. An observed increase in resistivity was found to be proportional to concentration of admixture content (for small content of admixture). The concentration was found to be proportional to the square root of the pressure. It was concluded that during the quenching of silver in air, the increase in electrical resistivity is basically due to the fixation of the oxygen dissolved in the silver, whereas the increase in resistivity after the quenching of silver, when heated in pure helium (oxygen content less than or equal to 0.01%), is due basically to the detention of vacancies. The energy of formation was determined for the latter case and found to be 24,000 cal/mole. P.V.E.

N64-19267 Massachusetts Inst. of Tech., Cambridge
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report, October 15, 1963

J. C. Slater et al [1963] 91 p refs
(Contract Nonr-1841(34); NSF Grant 24908; Contract AF 19 (628)-356)
(QPR-50; AD-420620)

Papers presented include: (1) nonempirical LCAO–SCF (limited configuration atomic orbital-self-consistent field) calculation of formyl fluoride with gaussian atomic orbitals; (2) nonempirical calculations on the ethylene molecule; (3) SCF calculations on water using gaussian functions; (4) molecular integrals over Slater orbitals; (5) configuration interaction; and (6) energy bands in silver chloride. J.E.T.

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-18570 National Engineering Science Co., Pasadena, Calif.
NEW CHEMICAL EXTINGUISHING AGENTS FOR ROCKET PROPELLANT AND METALLIC FIRES Technical Documentary Report [Feb. 1962–Oct. 1963]
Herbert Landesman and Eugene B. Klusmann Wright-Patterson AFB, Ohio, Res. and Tech. Div., Dec. 1963 72 p refs
(Contract AF 33(657)-8015)
(RTD-TDR-63-4208; AD-427683)

Fluoroalkyl esters of boric, phosphoric, silicic, and sulfurous acids, boroxines, and alkoxydifluoroborane trimers have been prepared as possible extinguishants for metallic and/or exotic propellant fires. Their mode of action is to form an inorganic oxide coating on metals. For propellants, they dissolve the fuel and produce nonflammable dilute solutions. The fluoroalkyl groups utilized have been $H(CF_2CF_2)_xCH_2$, where x = 1, 2, 3 and, in the borate case, 4. Attempts to prepare fluoroalkyl esters of aluminic acid gave products that could not be purified. Fluoroalkoxydifluoroborane trimers and fluoroalkyl sulfate esters could not be prepared. Physical properties, stabilities, and compatibilities with materials of construction and with metals and propellants are reported for all materials synthesized. It was found that nonflammable solutions containing esters with pentaborane and with hydrazines could be prepared. Author

N64-18618 Stanford Research Inst., Menlo Park, Calif.
VISCOELASTIC PROPERTIES OF SOLID PROPELLANTS AND PROPELLANT BINDERS
Nicholas W. Tschoegl, James R. Smith, and Thor L. Smith 15 Feb. 1964 45 p refs
(Contract NOw-64-0073-d; ARPA Order 22, Amend. 60)
(AD-434853)

Improvements have been made in the design and operation of the low-frequency dynamic shear tester. Special techniques have been evaluated for determining precisely the phase angle between the applied displacement and the resultant force. In addition, theoretical work was directed toward determining the manner in which the specimen shape-factor depends on the laterally applied compressive force. A complete description is given of a dynamic bulk compressibility apparatus and of the calibration and evaluative work done to date. Also described is a new apparatus for determining the static (isothermal) bulk compliance over an extended temperature range at pressures up to about 3,000 psi. Factors that influence the effective gage length of both end-bonded and JANAF tensile specimens of the PBAN propellant TP-H-1001 were evaluated. It appears that reliable strain data can be obtained only by determining directly the strain produced in the gage section during tests at various temperatures and crosshead speeds. Author

N64-18643 Naval Ordnance Lab., White Oak, Md.
ESTIMATION OF HIGH AND LOW PROBABILITY EED FUNCTIONING LEVELS
L. D. Hampton, J. N. Ayres, and I. Kabik 3 Feb. 1964 13 p refs
(NOLTR-63-266; AD-434821)

Predicting very high or low EED response probabilities usually requires extrapolation from limited data. Extrapolation errors will be increased by inappropriate test plans or statistical treatment. Various test plans are discussed. Possible new prediction techniques are suggested. The necessity for careful design of experiment is stressed. Author

N64-18673 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTENSIFICATION OF HOMOGENEOUS COMBUSTION BY LOW-FREQUENCY OSCILLATIONS
B. M. Gunko and V. V. Solovev 15 Jul. 1963 28 p refs
Transl. into ENGLISH from Tr. Inst. Goryuch. Iskop., Akad. Nauk SSSR (Moscow), no. 18, 1962 p 64–77
(FTD-MT-63-50/1+2; AD-434966)

A discussion is presented of the theory that oscillations can be special aerodynamic processes connected with the formation and breakdown of vortexes. Experimental results were obtained that confirm theoretical predictions concerning the intensifying influence of low-frequency pulsations on the process of homogeneous combustion. R.T.K.

N64-18732* Ohio State U., Columbus
HIGH-SPEED PHOTOGRAPHIC INVESTIGATION OF THE FORMATION OF DETONATION WAVES IN A STOICHIOMETRIC HYDROGEN-OXYGEN MIXTURE
James A. Laughrey, Loren E. Bollinger, and Rudolph Edse Washington, NASA, Apr. 1964 50 p refs
(NASA Grant NsG-44-60)
(NASA TN D-2242) OTS: $1.25

An experimental investigation was undertaken to elucidate the mechanism of the transient process. High speed photography was utilized to study the process at various stages from ignition to a fully established detonation. A modified shadowgraph system and an image converter camera were employed. Exposure times in the submicrosecond region were used to stop the motion. The discussion pertains primarily to an explanation of the wave structure rather than to a detailed mathematical analysis. Author

N64-18742 Aeronutronic, Newport Beach, Calif. Research Lab.
AN EXPERIMENTAL PROGRAM FOR OBTAINING THE THERMODYNAMIC PROPERTIES OF PROPELLANT COMBUSTION PRODUCTS Final Technical Report
D. L. Hildenbrand, L. P. Theard, W. F. Hall, F. S. La Viola, F. Ju et al 15 Dec. 1963 22 p refs
(Contract NOw-61-0905-c)
(U-2403; AD-427831)

Some preliminary studies of the free evaporation of crystalline boron have been made by the torsion–Langmuir method in the range 1,950° to 2,130° K. The results indicate a vaporization coefficient close to unity and a boron heat of sublimation

of 136 ±1 kcal/mole at 298° K. The latter is in good agreement with a value obtained earlier from B_4C decomposition pressure studies. The entropies of a number of Group II gaseous metal dihalides have been reviewed, and it is concluded that the available molecular constant–spectroscopic data for the Be, Mg, and Zn dihalides yield entropies that are too low by 5 ±1 e.u. There is indirect evidence that this discrepancy may be due to the use of bending frequencies that are too high. The thermodynamic data obtained from the program to date have been summarized, and the status of the data for each species is briefly reviewed. Author

N64-18744 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
EXPERIMENTAL TECHNIQUES FOR THE STUDY OF FLAME STRUCTURE
Robert M. Fristrom Jan. 1963 193 p refs
(Contract NOw-62-0604-c)
(*Its* Bumblebee Ser. Rept. No. 300; AD-429928)

The following areas, pertinent to the development of techniques for studying the microstructure of flame fronts, are discussed: (1) burner systems; (2) the local aerodynamics of flame fronts; (3) the experimental determination of local temperatures in flame fronts; (4) the determination of the composition of stable species in flames; (5) the determination of the concentration of unstable species in flames; and (6) distance measurements in flames. I.v.L.

N64-18761 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING A DEVICE FOR THE DETONATION OF LIQUID EXPLOSIVES
A. N. Dremin, O. K. Rozanov, and V. S. Trofimov 19 Jul. 1963 11 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekh. Fiz. (Moscow), no. 1, 1963 p 130–132
(FTD-MT-63-78/1+2; AD-434956)

The speed of detonation and the dimensions of Δ heterogeneities on charges of nitromethane and nitromethane mixed with acetone were measured. All measured magnitudes referred to a stationary detonation. The measurements showed that the speed of detonation falls with the increase of concentration of acetone in the mixture; this leads to a lowering of the temperature behind the shock front of a detonation wave and an increase of reaction time. The dimensions of heterogeneities in this case are increased. The diameter of the detonation of the liquid explosions was determined by the transition of the detonation from a narrow pipe to a wide one. I.v.L.

N64-18779 Naval Research Lab., Washington, D.C.
A NEW VAPOR-SECURING AGENT FOR FLAMMABLE-LIQUID FIRE EXTINGUISHMENT
R. L. Tuve, H. B. Peterson, E. J. Jablonski, and R. R. Neill 13 Mar. 1964 48 p refs
(NRL-6057; AD-435612) OTS: $1.25

A study and testing program has resulted in the development of new water-soluble surfactants of the perfluorocarbon type capable of forming vapor-securing foams and films on the surface of low-flashpoint flammable fuels of the gasoline type. Equipment has been designed and developed for successful one-man application of these foams immediately following flame extinction with the free-radical quenching agent, potassium bicarbonate dry chemical, on a pound-for-pound basis. Problems of foam collapse, usually encountered where dry chemicals and vapor-securing foam agents are used together, are nonexistent with the new perfluorocarbon foam surfactant. Because of its action on low-density hydrocarbon surfaces, the new foam has been named "Light Water." Author

N64-18816 Midwest Research Inst., Kansas City, Mo.
MASS SPECTROMETRIC SAMPLING OF FLAMES
T. A. Milne, J. Brewer, and F. T. Greene *In* JPL Proc. of the 1st Meeting of the ICRPG Working Group on Thermochem., New York, 5–7 Nov. 1963, Vol. 1 Feb. 1964 p 123–138 refs (See N64-18801 11-13)

The pertinence of the Kantrowitz and Grey theory of aerodynamic molecular beams to the problem of sampling high-pressure systems with a mass spectrometer is discussed. A simple differentially pumped molecular beam system is described, which gives molecular beams of intensities of about 10^{17} molecules/cc/sec from 1 atm sources. The behavior of this sampling system with pure gases, mixtures, and reactive systems is presented. In beams from gaseous mixtures the mass spectrometer gives a response that depends on the first power of the component molecular weight: $I_x + = kP_xm_x$. Under many sampling conditions a series of polymers or clusters of even the rare gases are formed during the initial expansion process. Author

N64-18862 Stanford Research Inst., Menlo Park, Calif.
CHEMICAL KINETICS AND GAS DYNAMICS OF ATOM AND FREE-RADICAL REACTIONS
Henry Wise, Clarence M. Ablow, Kenneth M. Sancier, and Bernard J. Wood *In* Va. U. Project Squid 1 Apr. 1964 p 49–57 refs (See N64-18851 11-24)

The presence of atomic and charged species in advanced propulsion systems requires a detailed understanding of the transport properties and reaction kinetics of gas mixtures containing such labile species. This report discusses: (1) the interaction of atoms with solid surfaces wherein the solid surface exposed to a reactive gas may act as a catalyst as well as a reactant; (2) the homogeneous, gas-phase kinetics of atoms and ions, specifically, the rate of the reaction $OH + H_2 \rightarrow H_2O + H$; and (3) the transport properties of reacting gases with emphasis on measurements of the thermal conductivity of mixtures of O and O_2. Experimentally, the reacting species are produced in an electrodeless gas discharge. The progress of the reaction—either homogeneous, heterogeneous, or both—is determined by means of electron-spin resonance and microcalorimetric techniques under steady-state conditions. I.v.L.

N64-18864 Atlantic Research Corp., Alexandria, Va.
SOLID-PROPELLANT FLAME MECHANISMS
R. Friedman, A. Maček, and J. M. Semple *In* Va. U. Project Squid 1 Apr. 1964 p 63–65 refs (See N64-18851 11-24)

The mechanisms of solid-propellant combustion were investigated by studying the combustion of single metal particles (aluminum or beryllium) injected into flame gases of known temperature. Systematic observations of burning aluminum particles, made by a technique using magnifying photography, revealed fine details of two rather different modes of combustion of aluminum, vapor combustion, and a peculiar quasi-surface combustion. Combustion of beryllium powder in a closed bomb, which has given somewhat rough but quantitatively reproducible data on the ignition of particles over a wide range of temperatures and pressures, has been completed. The study of the combustion of beryllium particles under more closely controlled ambient conditions at atmospheric pressure has begun. Preliminary results have been obtained with nonspherical beryllium particles, averaging about 40μ in diameter.

The particles, injected into product gases of propane–oxygen–nitrogen flames, show a dull red glow at all ambient temperatures above about 2,200° K, indicating some self-heating. However, bright burning was observed only with relatively small particles at the highest temperatures of about 2,700° K, and after a maximum residence time at those temperatures (10 to 12 sec), attainable with the propane flames on the burner employed. Larger particles do not have sufficient time to heat to the ignition temperature. I.v.L.

N64-18887 Army Missile Command, Huntsville, Ala. Propulsion Lab.
EFFECT OF FILLER CONCENTRATION ON THE VISCOELASTIC RESPONSE OF A COMPOSITE SOLID PROPELLANT
Donald L. Martin, Jr. 2 Mar. 1964 39 p refs
(RK-TR-64-2; AD-433612)

An investigation was conducted to determine the effect of volume fraction of filler on the viscoelastic response of the PBAA propellant system. Formulations containing up to 84% filler fraction were investigated in uniaxial tension with strain rates varying from 0.05 to 5.0 inches per inch per minute and temperatures of 180° to −90° F. A modification of the Williams, Landel, Ferry relationship, relating time to changes in temperature, was satisfactorily applied to the reduction of the test data. Close agreement between calculated and experimental values of log α_T was obtained for all formulations. Mechanical response spectra are presented for maximum stress, modulus, strain, strain-energy-density at failure, and for the stress–strain relationship, indicating the dependence of these parameters on strain rate, temperature, and filler fraction. Author

N64-18890 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
VIBRATIONAL COMBUSTION
B. V. Raushenbakh 16 Apr. 1963 525 p refs Transl. into ENGLISH of "Vibratsionnoye Goreniye", Moscow, Gosizdat. Fiz.-Mat. Lit., 1961 p 1–500
(FTD-TT-62-942/1+2; AD-402909)

This book is devoted to the problem of combustion-process instability encountered in the design of liquid-fuel rocket engines, air-breathing jet engines, highly forced fireboxes in chemical electric-powerplants, and in conducting various types of physical tests and experiments in combustion theory. It gives a systematic exposition of contemporary theory of the excitation of longitudinal acoustic vibrations by application of heat. The qualitative laws inherent in this type of vibration are given detailed consideration, with information from hydromechanics, acoustics, and combustion, with information from hydromechanics, acoustics, and combustion theory drawn upon extensively for their analysis, and with application of the mathematical apparatus of control and vibration theories.
Author

N64-18905 Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.
Quarterly Progress Report on Engineering Research, 15 September–15 December 1963 [A METHOD FOR DETERMINING THE THERMAL DIFFUSIVITY OF SOLID PROPELLANTS]
Donald E. Mastin 6 Mar. 1964 20 p refs
(Contract DA-01-021-ORD-11878(Z))
(P-63-27; AD-433635)

A method for the determination of the thermal diffusivity of solid propellants was developed based on the transient temperature response of a propellant specimen. The method is simple, accurate, and well suited to materials of low diffusivity.
Author

N64-18997 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MEASURING METHODS SERVING TO EVALUATE THE DEGREE OF PERFECTION OF COMBUSTION CHAMBERS
Jozef Jarosinski 18 Mar. 1963 18 p Transl. into ENGLISH from Tech. Lotnicza (Poland), no. 7, Jul. 1962 p 195–201
(FTD-TT-63-23/1+2; AD-402435)

Methods for approximating the degree of efficiency of combustion chambers are described. These are: (1) a method for describing the efficiency of combustion with the aid of an approximate temperature value of the combustion gases; (2) a method for describing the pressure factor with the aid of an approximate value of mean dynamic pressure; and (3) a method for describing the relative pulse and pulse factor by measuring static and dynamic pressures at input and output of the combustion chamber. The value of these methods is felt to lie in the fact that they do not require measurement of the temperature of hot combustion gases. The measured values are static and dynamic pressures in the section at the input and output of the combustion chamber as well as the air temperature in the section at the input into the chamber.
R.T.K.

N64-19142 Stanford Research Inst., Menlo Park, Calif.
VISCOELASTIC PROPERTIES OF SOLID PROPELLANTS AND PROPELLANT BINDERS Quarterly Technical Summary Report No. 1, 15 Jul.–15 Oct. 1963
Thor L. Smith and James R. Smith 1963 5 p
(Contract NOw-64-0073-d; ARPA Order 22; Amend. 60)
(AD-436695; Rept. 9)

Information on work completed and on studies in progress in the following areas related to solid propellants and propellant binder development is presented: (1) dynamic shear properties; (2) dependence of specific volume on pressure, temperature, and time; and (3) large deformation tensile properties at constant strain rates.
R.T.K.

N64-19146 Underwriters' Labs., Inc., Chicago, Ill.
FIRE TEST OF WOODEN-JACKET SHIELD FOR RADIOISOTOPE SHIPPING CONTAINER
Leonard H. Horn 23 Mar. 1964 41 p
(Contract AT(11-1)-1022)
(COO-275) OTS: $0.75

A standard 1-hr fire test has been conducted upon a design sample of a wooden-jacket shield for radioisotope shipping containers under controlled conditions equivalent to similar tests upon safes, record-protection cabinets, etc., which may be exposed to fires in buildings, warehouses, and comparable structures. The sample had been partially filled with approximately 2,600 lb of lead bricks and subjected to a 30-ft drop test prior to the fire test. The standard 1-hr fire is one in which the following temperatures are attained in the test furnace: 1,000° F after 5 min; 1,300° F after 10 min; 1,550° F after 30 min; and 1,700° F after 1 hr. The maximum temperature measured within the shield was 210° F at the end of the 1-hr test period. Immediately following the fire test, the sample was subjected to a standard 1-min hose stream test. The shield successfully withstood the tests without collapse and without subjecting the enclosed lead bricks to temperatures exceeding their melting point.
Author

N64-19177 Naval Research Lab., Washington, D.C.
THE PROBLEM OF JET FUEL CONTAMINATION
J. A. Krynitsky *In its* Rept. of NRL Progr. Dec. 1963 p 1-7 refs (See N64-19176 11-01)
OTS: $1.25

Serious cases of aircraft wing tank corrosion, fuel gage malfunctions, and other fuel system difficulties have been experienced in both military and commercial aircraft for the past several years. These troubles have been caused by the presence in the fuel of such contaminants as water, particulate matter, microorganisms, and surfactants. This paper discusses the nature of these contaminants, the interrelationship of these substances in causing aircraft fuel system damage, and practical methods for effecting control over the problems. Author

N64-19215 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT THE MAIN CAUSES OF THE DIFFERENCE BETWEEN INITIATING AND SECONDARY EXPLOSIVE SUBSTANCES
K. K. Andreyev 9 May 1963 6 p refs Transl. into ENGLISH from Kokl. Akad. Nauk SSSR (Moscow), v. 146, no. 2, 11 Sep. 1962 p 413–414
(FTD-TT-63-325/1; AD-415652)

The factors that cause the initiating explosive substances to become hot at lower pressures, in a shorter time, and also cause them to be much easier to ignite than the secondary explosive substances are discussed. R.T.K.

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-18597 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
FEASIBILITY DEMONSTRATION OF A TRANSPIRATION COOLED NOZZLE SYSTEM Third Interim Report, 15 Dec. 1963-14 Mar. 1964
[1964] 49 p
(Contract AF 04(611)-9071)
(ER-5209-Q3; RPL-TDR-64-42; AD-435834)

This report discusses the design, analysis, and fabrication of a porous-tungsten transpiration-cooled, test module. The design and analysis for the first throat-module test were completed, including verification of the joining method selected. Fabrication of the module components has been completed, and final assembly has been initiated. Simulated test runs using liquid NH_3 have been made to verify cooling system operation. Bench tests to verify pressure shock loading, infiltrated-graphite performance, hydrogen–tantalum reactivity, and cooling effectivity were completed. Author

N64-18671 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ROCKET MOTORS
E. B. Volkov 12 Apr. 1963 91 p Transl. into ENGLISH from the publ. Raketnaya Tekhnika, Moscow, Military Publishing House, 1961 61 p
(FTD-MT-63-44/1+2; AD-434968)

This report, concerned with rocket weapons, deals mainly with their principle of operation, characteristics, classification, and prospective development. I.v.L.

N64-18719 McGill U., Montreal, Canada Mechanical Engineering Research Labs.
ANNUAL PROGRESS REPORT OF THE HYPERSONIC PROPULSION LABORATORY [OCT. 1962-Nov. 1963]
S. Molder et al Nov. 1963 61 p refs
(Def. Res. Board Grant G-9550-06)
(Memo 63-3)

The current status of the following investigations is presented: hypersonic ramjet performance; gun-launched hypersonic ramjet performance; hypersonic boundary layers in adverse pressure gradients; rotational flow calculation; shock reflection and interaction at hypersonic speeds; the development of a general program for the calculation of supersonic and hypersonic flow behind curved shock waves; hypersonic turbulent flow over compression surfaces; supersonic combustion of hydrogen with downstream injection; supersonic combustion of hydrogen with cross-stream injection; mixing of supersonic turbulent streams of nonsimilar fluids; entropy increase in nonequilibrium flow; optimim nozzle profiles; viscous flow of reacting gases; design and construction of a hypersonic shock tunnel (St-2); instrumentation and calibration of the high-performance shock tunnel (St-2); calculation of shock tunnel (St-2) performance; detonation-free ignition of a mixture of helium, hydrogen, and oxygen at high pressures; high-temperature heat-transfer probe; catalytic recombination of hydrogen-air combustion products in a supersonic nozzle; and the effect of liquid injection into the boudary layer of a high-enthalpy supersonic flow. I.v.L.

N64-19293* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RESEARCH ON RESISTANCE-HEATED HYDROGEN THRUSTORS
John R. Jack, Ernie W. Spisz, and Paul F. Brinich Washington, NASA, Apr. 1964 27 p refs
(NASA TN D-2281) OTS: $0.75

Experimental results are presented for two types of resistance-heated hydrogen thrustors. One type has a low-resistance tabular heat exchanger and is water cooled, whereas the other has a high-resistance wire-coil heat exchanger and is radiation cooled. Experimental data are presented for propellant flow rates varying from 2.5×10^{-4} to 10^{-3} lb/sec and electrical input powers as high as 38 kw. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-18584 Centro di Studi di Fisica Dello Spazio (Italy) Osservatorio Astronomico di Roma
SOLAR MAGNETIC FIELDS Technical Final Report, 1 Feb. 1963-31 Jan. 1964
Massimo Cimino 1964 31 p refs
(Grant AF-EOAR 63-88)
(AFCRL-64-114; AD-434681)

Instrumentation was developed for study of solar magnetic fields and associated solar phenomena. Special attention was paid to the completion of the instruments in the great Solar Tower, and particularly, to the 18-m spectrograph. Another

spectrograph, measuring 2.20 m, was also put into operation. An apparatus for measuring sunspot magnetic fields was completed and put into operation, and the draft plan of a Babcock-type magnetograph for the general magnetic field of the sun was drawn up. Associated instrumentation for the study of chromospheric phenomena includes, in particular, one large new equatorial mounting and one smaller one for solar cinematography with Lyot filter in the H_α and K ionized calcium line. Another Lyot H_α filter has been put into operation (at the Tower) for setting the slit of the spectrograph on selected areas of the chromosphere. A detailed description of the instrumentation is presented. R.T.K.

N64-18642 Minnesota U., Minneapolis
THE MODULATION OF HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION
P. S. Freier and C. J. Waddington Feb. 1964 31 p refs
(Contract Nonr-710(19))
(CR-70; AD-434176)

The intensities of the primary cosmic ray heavy nuclei, $Z \geq 3$, have been studied during several Forbush decreases. Fifteen values of the intensity were measured using nuclear emulsion detectors flown during a balloon cosmic ray monitoring program. The values are those observed before, during, or after four of the largest Forbush decreases that occurred in the last solar cycle. Examination of these data, together with data previously available in the literature, suggests that the heavy nuclei are modulated in a manner similar to the α-particles and protons of the primary radiation, showing that the modulation process is not strongly charge dependent. Author

N64-19156 Kiruna Geophysical Observatory (Sweden)
ON THE LARGE PROMINENCE OF APRIL 12-14, 1963
Ludwik Liszka Repr. from Arkiv Astron. (Stockholm), v. 3, no. 25, 1963 p 325-332 refs
(*Its* Medde. 53)

The large solar prominence of April 12 to April 14 was first observed at 0600 UT on April 12 at the western limb approximately between 295° and 310° of the heliographic position angle, $P_\odot$. This prominence could not be identified with any filament previously observed on the solar disc. The form of the prominence changed during the entire observation period. No influence of the occurring flares on the prominence was observed. On April 13, four bright surges (BSL) of importance 1 were observed. On April 14, two surges of importance 1 and one of importance 2 were observed. A clear dependence of the form of the prominence on the occurrence of bright surges at $P_\odot \approx 295°$ was observed. In particular, the lower and upper boundaries of the prominence at $P_\odot \approx 250°$ were strongly influenced. Finally, the BSL of importance 2 of April 14 caused violent changes of the whole prominence and its disappearance at about 1,300 UT. Two dark surges were observed in a spot group near the central meridian after the disappearance of the prominence. On April 13, when the prominence had the highest intensity, measurements of the apparent motion of small structure "knots" were made. Most of the "knots" had velocities of less than 2 km/sec. Some of them, notably those located in the outer regions of the prominence and showing thin structures approximately perpendicular to the axis of the arc, had velocities up to 8 km/sec. I.v.L.

N64-19231 Centre National d'Études des Télécommunications, Issy les Moulineaux (France)
THE AEROBEE EXPERIMENT AT WALLOPS ISLAND IN OCTOBER 1963. PROGRAMME "FR-1", PART 1 C: TEXT
L. R. O. Storey, C. Renard, and G. Driancourt Feb. 1964 16 p refs
(Tech. Rept. 327-TC)

One Aerobee objective was the trial of methods for measuring local electron density in the ionosphere from observations of the properties of the VLF wave field. Since the wave-admittance method could not be tested properly due to uncertainty in the behavior of the electric antennas, electron-density profiles were determined by the joint measurement of the Doppler effect and the direction of propagation. The direction of propagation could not be determined from the measurements at this stage and was assumed to be vertical. In the first firing, there was reasonable agreement between the electron-density profile calculated from the VLF data and that determined by true-height analysis of a simultaneous ionosphere sounding; in the second firing, the VLF and true-height data disagree. Additional conclusions are given concerning the properties of the VLF wave field and the behavior of the electric antennas. R.L.K.

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-18788 RAND Corp., Santa Monica, Calif.
A WATER-CLOUD INTERPRETATION OF VENUS MICROWAVE CONTINUUM
D. Deirmendjian Apr. 1964 37 p refs
(Contract AF 49(638)-700)
(RM-4060-PR; AD-434501)

The most recent microwave brightness determinations of Venus are analyzed in the light of new theoretical results concerning the equivalent scattering and absorption properties of typical terrestrial clouds and precipitation. Based on the argument that the analysis of existing data does not conclusively demonstrate the absence of large amounts of water in the lower Venusian atmosphere, it is shown that a 600° K surface temperature and a planet-wide continuous and thick water-cloud veil are consistent with the observed microwave brightness distribution in the millimeter and centimeter range. The total water content of this veil is estimated at 10 gm cm^{-2}. The surface pressure of the sustaining atmosphere may be as low as 3 atm. Author

N64-18900 Naval Postgraduate School, Monterey, Calif.
A COMPARISON BETWEEN SOME METHODS FOR COMPUTING OPTIMUM PATHS IN THE PROBLEM OF BOLZA
Frank D. Faulkner Mar. 1964 13 p refs Presented at the Conf. in Computing Methods in Optimization Probl., Calif. U., Los Angeles, Jan. 1964
(*Its* Res. Paper 43; AD-434225)

A comparison is made between methods for calculating optimum trajectories in the problem of Bolza. For the most part the comparison is between the method of steepest ascent as given by Bryson and Denham and a direct method due to the author, using the differential techniques which G. A. Bliss developed during World War I in ballistics. A second purpose of the paper is to give a modification of Bryson and Denham's method that eliminates one of the minor subproblems and makes

it possible to use a trajectory obtained by their method to start the routine for the other method. The reason for this is given. Both methods use the adjoint system of differential equations as used by Bliss; the adjoint system seems imperative for the solution and understanding of all but the simplest problems. Author

N64-18956* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF MAGNETICALLY INDUCED EDDY-CURRENT TORQUES ON SPIN MOTIONS OF AN EARTH SATELLITE
G. Louis Smith Washington, NASA, Apr. 1964 29 p refs
(NASA TN D-2198) OTS: $0.75

One of the sources of torques on near-earth satellites is the interaction of the earth's magnetic field with eddy currents induced in the electrically conducting parts of a spinning satellite. Initially, it is assumed that the geomagnetic field is that of a space-fixed dipole. The equation for the average torque, due to this effect, acting on a satellite of known properties is derived and presented. This equation shows the variation of the torque with the orbital parameters. The time history of the spin vector as influenced by this torque has been investigated. For the general case, the spin vector can be resolved into three orthogonal components, which are damped exponentially at three different rates. The analysis is extended to include the effect of the tilt of the geomagnetic dipole axis with respect to the earth's spin axis. Author

N64-18957* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THEORETICAL STUDY OF ORBITAL ELEMENT CONTROL WITH POTENTIAL APPLICATIONS TO MANNED SPACE MISSIONS
James C. Howard Washington, NASA, Apr. 1964 59 p refs
(NASA TN D-2237) OTS: $1.50

To facilitate the modification of established lunar or planetary orbits, a simple method has been developed for determining the impulsive velocity increments required to make prescribed changes in the orbital elements. The direct determination of the velocity increments proceeds from a knowledge of the time rates of change of the orbital elements in the presence of perturbing forces. The simplification inherent in the present method involves the replacement of a set of differential equations relating the time rates of change of the orbital elements to the components of the perturbing force by a set of ordinary equations relating the orbital element increments to the components of the impulse vector. These equations are then solved by conventional methods to obtain the impulse vector required to make prescribed changes in the orbital elements. This procedure necessitates the omission of second and higher order quantities. Author

N64-19000 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
MOLECULAR OPTICAL THICKNESS OF LOW-DENSITY MODELS OF THE ATMOSPHERE OF MARS
E. L. Gray and K. L. Coulson Mar. 1964 32 p refs
(R64SD21)

Values of volume scattering coefficient and normal optical thickness for the revised estimates of the Martian atmosphere are given as a function of altitude above the planetary surface, for eight selected wavelengths from 2,500 to 10,000 A. Four models of the Martian atmosphere are used, the surface pressure for the models being 11 mb (2 models), 15 mb, and 30 mb. Comparisons with the previous higher-density atmospheric models for Mars, and with the U.S. Standard Atmosphere are shown, and the values of optical thickness are used to compute the energy directed outward from the top of a Rayleigh atmosphere on Mars. The computations show that the normal optical thickness is lower for the new models than for the previous models by approximately the ratio of the surface pressures. Author

N64-19032* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IN-PLANE LUNAR INJECTION OPPORTUNITIES FROM AN ORBITING SPACE STATION
William R. Wells Repr. from AIAA J., v. 2, no. 2, Feb. 1964 p 383–384
(NASA RP-160)

An injection delay will cause the lunar trajectory to be established in a plane having an orientation in space different from that originally planned. Consequently, the moon, in general, will not be at the nodal point of the earth satellite orbital and the earth–moon planes at the time the vehicle arrives there. It is possible to correct for the effects of regression by the application of a velocity increment to change the plane of the lunar trajectory. However, if the delays are to be of the order of days, as might be the case for a space station, then it is of interest to know that there are certain discrete intervals of time, after the nominal, in which injection into the lunar trajectory can be accomplished in the plane of the earth satellite orbit. Curves are provided which show that, for the majority of the nominal injection conditions, the opportunities for injection, after the first opportunity, occur about every 10.5 days. IAA

N64-19248 High Altitude Observatory, Boulder, Colo. IGY World Data Center A
INTERMEDIATE REPORT OF PROMINENCE (FILAMENT) ACTIVITY 1963
1 May 1964 50 p
(*Its* IGY Solar Activity Rept. Ser.-26)

This compilation of prominence data from the cooperating solar observatories includes daily prominence reports on the phenomenon observed, the time, the heliographic position, and the direction and extension of the outflow. R.T.K.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-18540* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF PRE-LAUNCH AND FLIGHT VIBRATION MEASUREMENTS ON THOR VEHICLES
S. A. Clevenson and W. B. Tereniak (Goddard Space Flight Center) *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 47–56 refs (See N64-18534 11-33)

A comparison of flight data for various nose fairings is presented. Results of a vibration survey on the forward equipment compartment of a Thor are compared with flight data, and the flight results are compared with payload environmental test specifications. Author

N64-18541* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATION STUDIES ON A SIMPLIFIED 1/2-SCALE MODEL OF THE NIMBUS SPACECRAFT
H. D. Carden and R. W. Herr *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 57–71 refs (See N64-18534 11-33)

Results are presented of experimental investigation of the effectiveness of various isolation and damping methods in reducing the dynamic response of a simplified scale model of the Nimbus spacecraft to vibratory inputs. Author

N64-18542 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missiles and Space Systems Div.
DYNAMIC ENVIRONMENTS OF THE S-IV AND S-IVB SATURN VEHICLES
R. W. Mustain *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 72–88 refs (See N64-18534 11-33)

A brief review of techniques used to predict the dynamic environments of the S-IV and S-IVB vehicles is presented, and these environments are summarized. This review includes discussions on the prediction of rocket exhaust noise, boundary-layer noise, sinusoidal vibrations, and random vibrations for the S-IV and S-IVB vehicles. In addition, sine-random vibration conversions are given. Author

N64-18544* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A COMPARISON OF THE VIBRATION ENVIRONMENT MEASURED ON THE SATURN FLIGHTS WITH THE PREDICTED VALUES
G. D. Johnston and T. Coffin (Chrysler Corp.) *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 102–129 refs (See N64-18534 11-33)

Preliminary vibration levels that would provide information to be used in equipment design for the Saturn vehicles were predicted from available Jupiter data and a limited amount of data from Saturn static firings. Actual data have now been obtained from recent Saturn launchings and static firings. A comparison of the actual versus predicted vibration environment is presented. Author

N64-18545* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A COMPARISON OF THE FLIGHT EVALUATION OF THE VEHICLE BENDING DATA WITH THE THEORETICAL AND DYNAMIC TEST RESULTS FOR THE SATURN I VEHICLE
Everette E. Beam *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 130–149 (See N64-18534 11-33)

A flight evaluation of the bending mode accelerometer data has been conducted for several Saturn I vehicles. The evaluation was conducted in order to determine the frequency trends of the vehicle bending modes during powered flight. In addition, mode shapes and actual amplitudes of deflection were desired for the periods of maximum response. In order to accomplish this data reduction, a digital program was developed using correlation and power spectral relationships. The program computes amplitude of response and phase relationships for the predominant frequencies in two or more accelerometer measurements. The results depend mainly upon the type and number of measurements available, and the magnitude and type of response measured. The results to date have been satisfactory, even on low level response. Author

N64-18546 Bendix Corp., Mishawaka, Ind.
CORRELATION BETWEEN MEASURED AND PREDICTED TRANSIENT RESPONSE OF THE TALOS AIRFRAME (IN SHIPBOARD STOWAGE) WHEN SUBJECTED TO A NEARBY UNDERWATER EXPLOSION
R. G. Alderson *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 150–160 refs (See N64-18534 11-33)
(Contract NOw 63-0193)

This paper discusses the development of a mathematical model of the Talos airframe as stowed aboard an ammunition supply ship, the predicted shock response, the experimental test methods and data, and the correlation between predicted and measured shock response. Author

N64-18547* National Aeronautics and Space Administration. Goddard Space Flight Center
PREDICTION OF FLIGHT ENVIRONMENT Panel Session
John C. New et al *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 161–171 (See N64-18534 11-33)

An edited version of the discussion that took place during this panel session follows. Not all comments are included, since some were repetitions of statements that were made earlier. Author

N64-18608 General Electric Co., Syracuse, N.Y.
SATELLITE RATED MISTRAM TRANSPONDER STUDY Final Report
Joseph Arrante et al 1 Nov. 1963 201 p refs
(Contract AF 19(628)-2992)
(AFCRL-64-36; AD-434793)

This final report is the result of a study program directed toward the generation of an equipment specification for a MISTRAM transponder capable of operating in an orbiting satellite. It considers the unusual environmental conditions that will exist in the proposed Calibration Satellite and the operational requirements that must be met for successful completion of the mission. It is also concerned with related hardware and activities, such as satellite antennas and field test equipment and programs. Author

N64-18640 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
FIXED-BASE AND IN-FLIGHT SIMULATIONS OF LONGITUDINAL AND LATERAL-DIRECTIONAL HANDLING QUALITIES FOR PILOTED RE-ENTRY VEHICLES Final Report
Edwin A. Kidd and Robert P. Harper, Jr. Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Feb. 1964 119 p refs
(Contract AF 33(616)-5823; Contract AF 33(616)-7753)
(TE-1516-F-1; ASD-TDR-61-362; AD-434076)

The research program utilized primarily a high-fidelity fixed-base ground simulator with evaluations made by three pilots. One of the three pilots also made in-flight evaluations of longitudinal flying qualities in the same vehicle, a three-axis variable stability airplane flown with a two-axis side controller and conventional rudder pedals. The program results are reported and discussed. Control sensitivity evaluations were compared to center stick results of earlier work. The longitudinal flying qualities as evaluated both on the ground simulator and in flight are compared and related to earlier investigations. Pilot rating variability, both interpilot and intrapilot, are quantized and discussed for the ground and flight experiments. Performance measures are reported. Author

N64-18730* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DESCRIPTION OF VEHICLE SYSTEM AND FLIGHT TESTS OF NINE TRAILBLAZER I REENTRY PHYSICS RESEARCH VEHICLES

William N. Gardner, Clarence A. Brown, Jr., Allen B. Henning, W. Ray Hook, Reginald R. Lundstrom et al Washington, NASA, Apr. 1964 92 p refs

(NASA TN D-2189) OTS: $2.25

A unique six-stage solid-fuel rocket system was designed for the purpose of performing experimental reentry physics research in such a manner that a test object is caused to reenter the atmosphere at ICBM speeds at a location near the launching site. Preliminary results obtained from flight tests of nine Trailblazer I vehicles indicated that the design concept of a rearward-firing reentry rocket research vehicle was valid. This system resulted in placing a small reentry body of hemispherical shape and of different materials close enough to ground-based optical and radar stations that good reentry data were obtained on six of the nine vehicles. Some problems with the vehicle became evident during the initial phase of the program but were eliminated as the program progressed. Author

N64-18731* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC AND ROCKET BRAKING OF BLUNT NONLIFTING VEHICLES ENTERING THE EARTH'S ATMOSPHERE AT VERY HIGH SPEEDS

Kenneth K. Yoshikawa and Bradford H. Wick Washington, NASA, Apr. 1964 39 p refs

(NASA TN D-2239) OTS: $1.00

A study has been made of the relative merits of aerodynamic braking, and combined rocket and aerodynamic braking of blunt nonlifting vehicles entering the earth's atmosphere at speeds varying from 25,000 to 60,000 fps. The study covered a wide range of heats of ablation of the heat shield, specific impulses of the rocket, entry angles, nose radii, and vehicle weight-to-area ratios. The assumed values of heat of ablation ranged from the heat required to vaporize Teflon to a value that is higher by a factor of 10. The values of specific impulse were appropriate for chemical, nuclear, and electrical propulsion devices. Radiation was the dominant mode of heat transfer for speeds in excess of about 40,000 fps. In treating this mode of heating, it was necessary to account for the self-absorption of shock-layer radiation and the shock-layer cooling that results from the radiation that is not absorbed. Author

N64-18764 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

BEFORE THE SIGNAL "LIFT OFF" SOUNDS

Daniil Pipko 24 Jan. 1964 10 p Transl. into ENGLISH from Ogonek (Moscow), no. 42, 14 Oct. 1963 p 31

(FTD-MT-63-224; AD-434971)

Possibilities of accomplishing interplanetary flight are discussed. Turbojet engines will lift the rocket into the air and accelerate it to a speed approximately 1 1/2 to 2 times the speed of sound. The ramjet engines will then be switched on. During liftoff to altitude, the turbojet engines will attain the upper boundary of their application and will stop, but the ramjet engines will lead the rocket to an altitude of approximately 40 to 50 kilometers. Once the spacecraft is in orbit, electric motors will accelerate the required velocity, not at once but gradually, making orbit after orbit around the earth. When the necessary velocity magnitude has been obtained, the spacecraft, being liberated from the earth's gravitational field, will depart to distant planets. It is possible to use aerodynamic forces in returning to earth if the spacecraft is supplied with wings on which the necessary force will be directed downward in a direction toward the center of the earth. The spacecraft will then be forced to cross into a satellite orbit, having the form of an ellipse. Moving along this orbit, the spacecraft will periodically pierce dense layers of atmosphere. The force of drag will periodically decelerate it, and the orbit will become circular. The same wings will help it descend from this orbit to the earth. Rotors may be used instead of wings for reentry and return. I.v.L.

N64-18955* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LUNAR MISSION PERFORMANCE EVALUATION PROCEDURE FOR ORBIT-LAUNCHED NUCLEAR VEHICLES

Robert E. Austin and George B. Kearns Washington, NASA, Apr. 1964 55 p refs

(NASA TN D-2157) OTS: $1.50

An estimation procedure is described, and reference data are presented by which the influence of certain design parameters and lunar mission velocity requirements can be determined for orbit-launched nuclear vehicles. The use of this procedure allows a rapid, unsophisticated method of calculating the performance of nuclear propulsion systems for specific lunar mission profiles. The performance parameters considered are as follows: payload ratio, characteristic velocity requirement, propellant ratio, flight path angle, central angle, burning time, and injection altitude. The effects of initial thrust-to-weight ratio, specific impulse, lunar transfer time, and initial orbital altitude are considered. The range of specific impulse assumed is restricted to that considered practical for nuclear heat exchanger propulsion systems. Author

N64-19060* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY ANALYSIS OF A SIMULATED METEOR REENTRY AT 9.8 KILOMETERS PER SECOND

W. O. Jewell and A. R. Wineman Washington, NASA, Apr. 1964 25 p refs

(NASA TN D-2268) OTS: $0.75

A brief description is made of the Trailblazer Ig artificial meteor experiment at a reentry velocity of 9.8 km/sec. The methods of obtaining data during the visible reentry and the corrections to the photographic data necessary for the final analysis are developed. A value of the luminous efficiency, or the percent of kinetic energy converted into visible light, is computed from the observed photographic data and is compared with that obtained by a classical meteor theory. The observed luminous efficiency of 9.55×10^{-4} is about 80 percent of the luminous efficiency of 1.17×10^{-3} computed from Öpik's 1958 classical meteor theory at an average velocity of 9.41 km/sec. The luminous efficiency for the artificial iron meteoroid is extrapolated to natural stony meteors of 15-percent iron at the same velocity, and it is found that the lower limit of the luminous efficiency of a stony meteor is 1.44×10^{-4} Author

N64-19076 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ANALYTICAL MODELS FOR AXIAL OSCILLATIONS CAUSED BY ENGINE STRUCTURE COUPLING IN MISSILES

N. A. Radovcich 25 Sep. 1963 52 p refs

(LMSC/A389580; SS/656/5351)

The present state-of-the-art in the mathematical simulation of longitudinal oscillations in missiles is presented. Models from several companies are reviewed. A generalized system for the missile, together with component definitions, are presented. Fixes proposed and used to correct or eliminate the

oscillation are reviewed. The development of a model for longitudinal oscillation on Thor–Agena vehicles is discussed. Author

N64-19227* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TEST PERFORMANCE AND DESCRIPTION OF A ROCKET VEHICLE FOR PRODUCING LOW-SPEED ARTIFICIAL METEORS
Clarence A. Brown, Jr. and Jean C. Keating Washington, NASA, Apr. 1964 47 p refs
(NASA TN D-2270) OTS: $1.25

The six-stage Trailblazer I vehicle with a seventh-stage shaped-charge accelerator was successful in producing an artificial low-speed iron meteoroid that reached a velocity at reentry of 32,100 ft per second. The flight test indicated that the performance of the vehicle was very close to the values indicated by preflight calculations. Optical data were obtained at three camera sites and yielded data necessary to compute for the first time the luminous efficiency of an artificial iron meteoroid reentering the atmosphere. Author

N64-19253* Goodyear Aerospace Corp., Akron, Ohio
M-1-L RE-ENTRY VEHICLE (WIND TUNNEL MODEL, FULL-SCALE) DESIGN, FABRICATION, AND TESTING Final Report, 10 Aug. 1962-15 Nov. 1963
30 Jan. 1964 123 p refs
(NASA Contract NAS2-1037)
(NASA CR-53716; GER-11141) OTS: $10.10 ph

The wind-tunnel model of the M-1-L vehicle consists of a hard forebody of wood and aluminum and a deployable-inflatable afterbody of fabric and "airmat." During the static test, an "airmat" failure occurred, necessitating failure analysis. Details of the failure and remedial action taken are included. A new M-1-L was fabricated and successfully passed its proof, static, and deployment tests. The significant accomplishments in major areas of effort are included in this report, which covers material preparation and testing, engineering analysis, detail design, model fabrication and testing, deployment-system description and operating instructions, and an operation log. The contract specifications for the M-1-L vehicle are presented in Appendix A, and a structural analysis of the wind-tunnel model is given in Appendix B. E.W.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

No abstracts in this issue.

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-18684 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SPACE SHIP RETURNS TO EARTH
K. Malyutin 6 Dec. 1963 11 p Transl. into ENGLISH from Kryl'ya Rodiny (USSR), no. 3, 1963 p 13–14
(FTD-MT-63-141; AD-434991)

All Soviet Vostok spaceships were lowered onto dry land in a given region. Approach to landing started several thousands of kilometers from the landing region. The satellite ships took a position by means of spatial orientation by the sun so that the thrust of the retroengines would be accurately directed in the direction opposite from the calculated trajectory of the flight. Spatial orientation of both the Soviet ships and the American Mercury capsules was accomplished remotely from earth. Step-by-step switching on mechanisms of deceleration and the confinement of ships to the descent trajectory were carried out also from earth, although onboard systems were provided that allowed astronauts to independently control landing. The descent of astronauts to earth in the last stage, when the velocity of the ship has been reduced to safe magnitudes, can take place along with the ship or separately by individual parachutes. Soviet astronauts were landed by parachute. According to the author, Mercury capsules were landed in the ocean because the deceleration device and control system of American ships do not insure sufficient accuracy to land in a given square. Methods of cooling spacecraft during reentry are discussed. I.v.L

N64-18891 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
STATISTICAL IMPACT PREDICTION FOR AEROBEE-HI ROCKETS
Louis D. Duncan and Bernard F. Engebos Mar. 1964 19 p refs
(ERDA-126; AD-434048)

Regression equations for impact prediction of the Aerobee-Hi rocket are derived. The evaluation of the equations and resulting errors are presented in the tables A comparison of these equations with the present field prediction techniques is also presented in the tables. Analysis shows that there is high probability that the errors do not follow a normal distribution. Author

N64-19287 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE, 1964, ISSUE 1
[1964] 53 p

A compilation of kinetheodolite observations of satellites is given. The observations were made over a period from September 1963 through January 1964, from COSPAR (Committee on Space Research) stations at Earlyburn, Herstmonceux, and Malta, and include time, azimuth, and elevation. Satellites observed include: 1960 Epsilon 3, Eta 1, and Eta 3; 1961 Alpha Delta 1; 1962 Beta-Alpha 2; 1963-30A; and 1962 Beta-Chi 1 during September and November 1963; and 1960 Epsilon

3, and Iota 1; 1961 Sigma 1; 1962 Kappa 1 and Beta-Chi 1; 1963-14A, -30A, -30D, -38A, and -53A; and 1964-04A and -04B, during January 1964. D.E.W.

N64-19292* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPIN DYNAMICS OF MANNED SPACE STATIONS
Peter R. Kurzhals and Claude R. Keckler Washington, NASA, Dec. 1963 61 p refs
(NASA TR R-155) OTS: $1.50

An analytical study of the dynamics of manned rotating space stations under various steady-state and transient excitations, such as docking impacts, attitude-system torques, and crew motion, has been conducted. The basic equations of motion for the spinning station are developed, and expressions simulating the applied disturbances are introduced. Two stability systems, a gyroscopic wobble damper and a proportional jet damper, are represented mathematically, and the motion of the station under the external disturbances has been determined with and without the effects of these stability systems. Computer results for a toroidal station are presented, and the effects of a variation in the moment-of-inertia distribution are discussed. Author

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-18534 Defense Dept., Washington, D.C. Office of the Director of Defense Research and Engineering
SHOCK, VIBRATION AND ASSOCIATED ENVIRONMENTS, PART II
Feb. 1964 323 p refs Presented at the 33rd Symp. on Shock, Vibration, and Assoc. Environ., Wash., D.C., 3-5 Dec. 1963 (*Its* Bull. 33; AD-432931)

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22. THE APPLICATION OF A COMPONENT ANALYZER IN DETERMINING MODAL PATTERNS, MODAL FREQUENCIES, AND DAMPING FACTORS OF LIGHTLY DAMPED STRUCTURES F. E. Hutton (GE) p 264-272 refs (See N64-18556 11-33)

23. THE EFFECTS OF FILTER BANDWIDTH IN SPECTRUM ANALYSIS OF RANDOM VIBRATION W. R. Forlifer (NASA. Goddard Space Flight Center) p 273–278 refs (See N64-18557 11-33)

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26. RANDOMNESS TESTER FOR ACOUSTIC SIGNALS E. D. Griffith (LTV Vought Aeron.) p 291–295 refs (See N64-18560 11-23)

27. RESPONSE OF A SINGLE-DEGREE-OF-FREEDOM SYSTEM TO EXPONENTIAL SWEEP RATES P. E. Hawkes (Lockheed Missiles and Space Co.) p 296–304 refs (See N64-18561 11-33)

28. THE INTEGRATED CORRELATION SYSTEM B. K. Leven (Navy Marine Eng. Lab.) p 305–309 refs

N64-18536 Aerospace Corp., Los Angeles, Calif.
REFLECTIONS ON SHOCK AND VIBRATION TECHNOLOGY
Charles T. Morrow *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 8–12 (See N64-18534 11-33)

Four new concepts in the areas of shock, vibration, and associated environments are discussed. These concepts have sharpened and refined shock and vibration theory. The first of these is power spectral density, the most important single concept in the application of random-noise theory to shock and vibration. The second concept is the shock spectrum, which has permitted a more refined comparison of shock severities. The residual shock spectrum is discussed as is mechanical impedance, which permits the prediction of linear loading effects on the basis of measurements made entirely at the interface. C.L.W.

N64-18537* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AN ENERGY METHOD FOR PREDICTION OF NOISE AND VIBRATION TRANSMISSION
Richard H. Lyon *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 13–25 refs (See N64-18534 11-33)
(Supported by NASA)

The problem of malfunction in components at high frequencies is reviewed. The overall problem is one of environmental excitation, acoustic and vibration transmission paths, and establishment of criteria for noise reduction through component criteria. Several aspects of the vibration path problem are described. Author

N64-18538* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A TECHNIQUE FOR PREDICTING LOCALIZED VIBRATION RESPONSE IN ROCKET VEHICLE STRUCTURE
R. E. Jewell *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 26–33 refs (See N64-18534 11-33)

The objective of this paper is to develop a prediction technique that is not based solely upon data acquired from similar vehicles. The total available energy concept is utilized with the localized vehicle structure regarded as an energy absorber. Acoustically induced vibrations are specifically treated by this method. Author

N64-18539 General Dynamics/Ft. Worth, Tex.
VIBRATION PREDICTION PROCEDURE FOR JET POWERED VEHICLES AND ITS APPLICATION TO THE F-111
N. I. Mitchell and H. E. Nevius *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 34–46 refs (See N64-18534 11-33)

A vibration prediction procedure that relates the structural vibration levels to external sound pressure levels on a jet powered vehicle is described. The application of this procedure to the F-111 program is presented, and other sources of vibration that must also be considered are discussed. Author

N64-18553 North American Aviation, Inc., Columbus, Ohio
AN ANALYTICAL SIMULATION OF THE DYNAMIC RESPONSE OF AN IMPACTING ELASTIC SYSTEM
R. E. Hess and W. L. Kammer *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 230–241 refs (See N64-18534 11-33)

A discussion is given of an analytical simulation of an impacting elastic system that could be used to furnish design parameters for a missile-launching system that can be air-dropped from a cargo aircraft. The primary purpose in accomplishing the simulation was to determine the missile-airframe dynamic loads resulting from the impact conditions. This analytical simulation was satisfactorily accomplished and produced significant numerical results from which design decisions could be made. From a description of the development of the mathematical model and of the computer mechanization, it is seen that this simulation can be extended in complexity, by the simple addition of computing equipment, to provide a very comprehensive representation of a complex dynamic system. This simulation proves to be a powerful tool in the design of impacting complex elastic systems, in that it provides accurate loading data early in the engineering design effort, and it also aids in the economical planning and executing of development testing. C.L.W.

N64-18555 Sandia Corp., Livermore, Calif.
TECHNIQUES FOR ANALYZING NONSTATIONARY VIBRATION DATA
P. T. Schoenemann *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 259–263 refs (See N64-18534 11-33)

This paper reviews the theory and problems associated with the analysis of nonstationary random vibration data. A practical method using comb filters is described. The results, when translated into vibration tests, tend to overtest in terms of rms value but ensure that each frequency band represents the extremes of the environment. Author

N64-18556 General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
THE APPLICATION OF A COMPONENT ANALYZER IN DETERMINING MODAL PATTERNS, MODAL FREQUENCIES, AND DAMPING FACTORS OF LIGHTLY DAMPED STRUCTURES
F. E. Hutton *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 264–272 refs (See N64-18534 11-33)

A system is described in which the quadrature and in-phase responses of acceleration are plotted versus frequency to determine modal frequencies and damping factors. An accelerometer is moved from station to station on the structure to plot out a graph of quadrature response versus station for each modal frequency selected, directly obtaining the modal patterns of the structure. Author

N64-18557* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECTS OF FILTER BANDWIDTH IN SPECTRUM ANALYSIS OF RANDOM VIBRATION
W. R. Forlifer *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 273–278 refs (See N64-18534 11-33)

The problem is treated both theoretically and experimentally, and the results obtained show excellent agreement. Curves are presented for the errors in both the width and magnitude of a resonant peak in terms of the ratio of measured resonant peak bandwidth to the analyzer filter bandwidth. Author

N64-18558 Collins Radio Co., Cedar Rapids, Iowa
RANDOM-SINE FATIGUE DATA CORRELATION
L. W. Root *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 279–285 refs (See N64-18534 11-33)

This paper presents the results of a study to verify a technique for predicting the random fatigue curve from the sine fatigue curve by making use of the Palmgren–Miner hypothesis of fatigue damage accumulation. Resonant cantilever beams were used to obtain the sine and random fatigue curves. The predicted curve was found to give a conservative estimate of life that was within less than one order of magnitude of the measured life. This result is in contrast to previous studies that gave nonconservative estimates of the measured random fatigue life. Author

N64-18561 Lockheed Missiles and Space Co., Sunnyvale, Calif.
RESPONSE OF A SINGLE-DEGREE-OF-FREEDOM SYSTEM TO EXPONENTIAL SWEEP RATES
P. E. Hawkes *In* Defense Dept., Wash., D.C. Shock, Vibration, and Assoc. Environ., Pt. 2 Feb. 1964 p 296–304 refs (See N64-18534 11-33)

The peak response and the number of cycles of a single-degree-of-freedom system is plotted for several damping conditions. The results are shown as functions of a dimensionless parameter that can be considered to be a measure of the sweep rate of the system. The results are related to vibration tests. Author

N64-18616 Pennsylvania State U., University Park Inst. for Science and Engineering
PLASTIC BUCKLING ANALYSIS OF RIB CORED CYLINDRICAL SANDWICH SHELLS SUBJECTED TO HYDROSTATIC PRESSURE Technical Memorandum
P. W. Hill (Ph.D. Thesis) 24 Mar. 1964 176 p refs
(Contract NOw 63-0209-c)
(AD-436033)

The buckling behavior of geometrically orthotropic cylindrical sandwich shells was studied throughout the linear and nonlinear stress range of the material. The shell configuration under study consisted of an outer and inner shell wall of equal thickness, separated by ribs running in either axial or circumferential directions. The optimum proportions for the circumferentially ribbed shell were determined with a high degree of success throughout the nonlinear stress range for 6061-T6 aluminum alloy. It was found that a broad range of proportions result in nearly optimum design at very high stress levels. For shells in the optimum range, the prebuckling stress ratio, $\bar{\sigma}_x/\bar{\sigma}_y$, was found to lie in a narrow region bounded by 0.52 and 0.62. It was found that a rib cored sandwich shell can be designed on an efficient weight-strength basis to resist failure by buckling up to the ultimate stress of the material. Author

N64-18681 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF COMPLEX NATURAL FREQUENCIES OF FLEXIBLE AIRCRAFT DEPENDING ON SPEED OF FLIGHT
V. B. Glasko and Yu. M. Romanovskiy 19 Dec. 1963 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 2, 1962 p 105–109
(FTD-MT-63-133; AD-434994)

The complex frequencies of a flexible wing with an aileron were investigated. The influence of the torsional vibration of the wing on the character of flexural aileron vibrations was considered. The problem was solved with the help of a high-speed electronic digital computer. R.T.K.

N64-18682 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOLUTION OF PLANE DYNAMIC PROBLEM OF THEORY OF ELASTICITY BY FOURIER SERIES
N. M. Borodachev 13 Dec. 1963 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 5, 1960 p 161–163
(FTD-MT-63-134; AD-434993)

The problem of using series for constructing solutions to certain dynamic problems of the theory of elasticity has been considered. This work presents known solutions to the problem of established vibrations of a rectangular strip. R.T.K.

N64-18694 Air Force Systems Command, Wright-Patterson AFB, Ohio Aeron. Systems Div.
COMPARISON OF APPROACHES FOR SONIC FATIGUE PREVENTION
Maurice J. Cote Sep. 1963 31 p refs Presented at the ASD 1963 Sci. and Eng. Symp., Wright-Patterson AFB, Ohio, 18–19 Sep. 1963
(ASD-TDR-63-704; AD-433020)

A generalized approach to prevention of sonic fatigue is presented that enumerates the necessary steps for the required prediction of fatigue life. Two approaches are primarily concerned with designing the initial structure with a satisfactory fatigue life. The other three approaches are to determine the fatigue life of structural designs by experimental tests prearranged to be representative of the true environments. The structural designs are then modified and improved to meet the necessary fatigue life requirements, thus preventing sonic fatigue during their expected normal service life. Author

N64-18700 Stanford U., Calif.
THE EFFECT OF RESTRICTING BUCKLE DEPTH IN CIRCULAR CYLINDRICAL SHELLS REPEATEDLY COMPRESSED TO THE BUCKLING LIMIT
W. H. Horton and S. C. Durham Nov. 1963 20 p refs
(Contract AF 49(638)-1276)
(SUDAER 174; AD-432763)

This paper demonstrates that the reduction in critical buckling load for a thin-walled cylindrical shell, which occurs under repeated compression, is a function of the depth to which the buckle is permitted to develop. It shows that a nickel cylinder whose R/t is of the order of 400 does not experience any load reduction on repeated load when the buckle depth never exceeds the thickness of the shell, and that buckle depths that are equal to or greater than 2.5t give the same results as are obtained in unrestricted buckling. It proves, too, that by using the method of buckle restriction it is possible to cause a cylindrical shell to buckle uniformly over its entire length. Author

N64-18769 Polytechnic Inst. of Brooklyn, N.Y.
AXISYMMETRIC, PLANE-STRAIN DYNAMIC RESPONSE OF A THICK, ORTHOTROPIC, VISCOELASTIC SHELL
Jerome M. Klosner and Clive L. Dym Feb. 1964 36 p refs
(Contract Nonr-839(32) (FBM); NSF Grant GP-1246)
(PIBAL-682; AD-433752)

The plane-strain, axisymmetric, thickness-stretch modes of a thick, orthotropic, viscoelastic shell embedded in a thin elastic casing are investigated. The steady-state dynamic response of the orthotropic, viscoelastic shell is obtained and compared with the response of the elastic shell. A higher-order shell theory is developed, and its accuracy for the lower modes is demonstrated. The effect of orthotropy on the rapidity of the transition from the free vibrations of a plate to that of a solid elastic circular cylinder is investigated. Author

N64-18778 Naval Research Lab., Washington, D.C.
ELEMENTS OF NORMAL MODE THEORY
G. J. O'Hara and P. F. Cunniff 15 Nov. 1963 31 p refs
(NRL-6002; AD-428774)

Elementary normal mode theory is derived and used in defining the dynamic response of linear elastic structures. The theory is derived from the definition of a linear elastic structure by using D'Alembert's principle and only those mathematical methods that are familiar to most engineers and that are no more complex than necessary. The cases of free vibrations and response to applied forces and base motion are examined in detail. Each normal mode is shown to respond to dynamic loads as a single-degree-of-freedom system with specific characteristics. Equations are developed for stress and deflection. It is shown that these can be converted to the form where the stresses or deflections are considered to be composed of two parts: one that ignores inertial effects (the static solution as a function of time) and one that represents a dynamic correction. Generalized Fourier expansions and characteristic load theorems are derived. The general problem of stresses and deflections is presented for arbitrary applied forces and base motions as well as for steady-state conditions. Author

N64-18842 Stanford U., Calif.
A NON-LINEAR MODEL STUDY OF THE THERMAL BUCKLING OF THIN ELASTIC SHELLS
Nicholas J. Hoff Nov. 1963 26 p refs
(Contract AF 49(638)-1276)
(SUDAER-173)

Analysis of the simple model proposed yields equilibrium curves in agreement with those obtained by other investigators for axially compressed thin-walled circular cylindrical shells. A rigorous calculation of the stability of the equilibrium of the model indicates that the snap-through phenomenon can be entirely absent when an imperfect shell is heated in a perfectly rigid testing machine. When the testing machine is sufficiently elastic, snap through will occur. It may take place at a temperature smaller than, equal to, or greater than $T = \epsilon_{cr}/\alpha$, where ϵ_{cr} is the theoretical critical strain of the perfect shell and α is the coefficient of expansion of the material of the shell, but the maximum stress produced in the imperfect shell will always be less than $\epsilon_{cr}E$, where E is Young's modulus of the material. Author

N64-18843 Stanford U., Calif.
REPEATED BUCKLING OF CIRCULAR CYLINDRICAL SHELLS AND CONICAL FRUSTA BY AXIAL COMPRESSIVE FORCES
W. H. Horton and S. C. Durham Nov. 1963 24 p refs
(Contract AF 49(638)-1276)
(SUDAER-175)

This paper reports the results of a series of tests made to determine the buckling behavior of circular cylinders and conical shells under repeated axial compression. It is shown that if the only restriction placed on buckle depth is that buckle development is such that no permanent gross strain results after load removal, then the buckle load progressively falls with repeated application until a constant lower bound is reached. This effect is considered to be due to the formation of plastic hinges along the edges of the buckles. Author

N64-18870 Aerojet-General Corp., Azusa, Calif. Von Karman Center
IMPROVED FILAMENT-WOUND CONSTRUCTION FOR CYLINDRICAL PRESSURE VESSELS. VOLUME I: STRUCTURAL ANALYSIS AND MATERIALS AND PROCESSES Technical Documentary Report, 1 Jul. 1961-31 Jan. 1964
F. J. Darms, R. Molho, and B. E. Chester Wright-Patterson AFB, Ohio, Materials Lab., Mar. 1964 212 p refs
(Contract AF 33(616)-8442)
(ML-TDR-64-43, Vol.1; Rept. 2784; AD-436272)

A design-optimization program was conducted that included stress analyses and the determination of design parameters, winding patterns, and fabrication techniques for filament-wound, cylindrical pressure vessels. An investigation of the materials, processes, and structural analyses required to efficiently utilize the improved mechanical properties of new glass fibers was also conducted, with the aim of improving filament-wound composite structures. Analytical studies preceded the selection of various design and fabrication concepts for optimum filament-wound pressure vessels with typical rocket-motor-case port openings. These selections were validated by a series of tests on model and full-scale chambers. Data are provided for use in the design and fabrication of optimum-weight, filament-wound cases. Author

N64-18879 IIT Research Inst., Chicago, Ill.
REVIEW OF STRUCTURAL DESIGN TECHNIQUES FOR BRITTLE COMPONENTS UNDER STATIC LOADS, VOLUME 2 Final Report, Feb.-May 1963
Ralph L. Barnett May 1963 132 p refs
(Contract AF 33(657)-8339)
(ARF-8259; AD-410497)

A systematic review of structural design techniques for brittle materials is conducted with particular emphasis on statistical fracture theories. The properties of both series and parallel statistical models are discussed, and a critical analysis is given for the experimental data that are available in the literature. The relationship of extreme value statistics to the fracture problem is thoroughly exploited. A survey of brittle test specimens and design rules-of-thumb is included, together with a number of very promising design philosophies. Author

N64-18883 Stanford U., Calif. Engineering Mechanics Div.
THE INFLUENCE OF VISCOELASTIC MATERIAL PROPERTIES ON DESIGN PROBLEMS
E. H. Lee Jan. 1964 29 p refs Presented at the Conf. on Thermal Loading and Creep in Struct. and Components, Inst. of Mech. Eng., London, May, 1964
(Contract Nonr 225(69))
(Tech. Rept. 146; AD-436014)

Viscoelasticity comprises an irreversible relation between stress and strain that is governed by time effects. Stress distributions for viscoelastic bodies subjected to constant loads

thus commonly vary with time. It is possible to utilize this flexibility of solution in some cases to meet stress design criteria. For example, the irreversibility embodied in viscoelasticity can lead to the production of a beneficial residual stress distribution following loading. Such an example is discussed. Temperature has a marked effect on viscoelastic characteristics, and thus supplies an additional controlling variable in selecting a design solution. Cooling slows down rate processes so that it may be possible to eliminate deleterious aspects of viscoelasticity in a particular design problem by selecting an appropriate temperature history. Author

N64-18950* National Aeronautics and Space Administration, Washington, D.C.
POST-BUCKLING BEHAVIOR OF CYLINDRICAL SHELLS. PART I: AXIAL COMPRESSION, PART II: EXTERNAL PRESSURE [TSILINDRICHESKIYE OBOLOCHKI PRI ZAKRITICHESKIKH DEFORMATSIYAKH. I: OSEVOYE SZHATIYE, II: VNESHNEYE DAVLENIYE]
A. V. Pogorelov Apr. 1964 162 p refs Transl. into ENGLISH from Izd. Khar'kovskogo Univ., Khar'kov, 1962
(NASA TT F-90) OTS: $3.00

Discussed is an investigation of the elastic state of compressed cylindrical shells under conditions of transcritical deformation, with emphasis on determining the lower critical load. Author

N64-18959* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
REVIEW OF SOME RECENT RESEARCH ON NOISE AND STRUCTURAL VIBRATION
R. H. Lyon and G. Maidanik Washington, NASA, Apr. 1964 54 p refs
(NASA Contract NASr-47)
(NASA TN D-2266) OTS: $1.50

A series of studies in the response of structures to sound and energy transfer between attached structures are discussed. The response of ribbed panels to sound fields is analyzed. The procedure for computing radiation loss factor, which measures the coupling between sound and structure, and the measurements of this parameter are described. Applications of the method are also made to estimate response of a large booster. Author

N64-19065 Aerojet-General Corp., Azusa, Calif.
IMPROVED FILAMENT-WOUND CONSTRUCTION FOR CYLINDRICAL PRESSURE VESSELS. VOLUME II – DESIGN PROCEDURES Technical Documentary Report, 1 Jul. 1961-31 Jan. 1964
F. J. Darms, R. Molho and B. E. Chester Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 68 p refs
(Contract AF 33(616)-8442)
(Rept. 2784; ML-TDR-64-43, Vol. 2; AD-435676)

Data are provided for use in performing stress analyses and determining design parameters, winding patterns, fabrication techniques, and buckling and stiffness criteria for optimum, filament-wound, cylindrical pressure vessels. Author

N64-19110 Massachusetts Inst. of Tech., Cambridge Aeroelastic and Structures Research Lab.
ON LARGE DYNAMIC DEFORMATIONS OF GENERAL SHELLS
Theodore H. H. Plan Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jan. 1964 40 p refs
(Contract AF 33(657)-8427)
(ASRL-TR-110-1; RTD-TDR-63-4271; AD-431303)

Equations are devised for the solution of the large dynamic response of general three-dimensional shells of elastic-plastic materials. The equations are written in tensor form. The equivalent finite-difference expressions for the various quantities are presented. The solution to the general shell problem involves the identical steps as for the two-dimensional structures. Author

N64-19120 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
STABILITY OF RODS IN THE STATE OF CREEP
V. F. Vorobyev 24 Mar. 1964 18 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1961 p 135–144
(RSIC-145; AD-436190)

The determination of the maximum life (critical time) of a compressively bent creep-deformed rod is being studied. The approximate solution is sought by Halerkin's method. It is shown that with appropriate assumptions it is possible to obtain equivalent solutions using the general variational principle developed by L. M. Kachanov. A similar problem concerning a rod subjected to axial forces has been solved. The approximate numerical formulas for the determination of the critical time are derived, and the result of computations is compared with the experimental data and with calculations of other authors. Author

N64-19137 General Dynamics/Fort Worth, Tex.
STIFFNESS CHARACTERISTICS OF SANDWICH TYPE FLUTTER MODEL CONSTRUCTION
A. C. Murphy 15 Apr. 1964 55 p
(Contract AF 33(657)-11214)
(ERR-FW-167; AD-436019)

The structural stiffness of sandwich construction was investigated to develop design and construction techniques that will insure consistent and predictable stiffness characteristics in flutter models. Specimens using various fabrication techniques and materials were tested and analyzed to determine the predictability of the stiffness. Flutter models can be designed using an equivalent sandwich construction and will have predictable characteristics if care and control are exercised in construction. Author

N64-19147* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
FLUTTER OF TWO PARALLEL FLAT PLATES CONNECTED BY AN ELASTIC MEDIUM
John A. Mc Elman Repr. from AIAA Journal, v. 2, Feb. 1964 p 377–379 refs
(NASA RP-156)

The flutter behavior of a structural configuration consisting of two rectangular, simply supported, parallel plates laterally connected by many closely spaced linear springs is investigated. (A figure shows the configuration analyzed.) This configuration is an idealization of a micrometeoroid bumper that is attached to a primary structure by a light, soft filler material. The aeroelastic behavior of such a configuration may be important in the design of structural components of a manned space station that are exposed to an airstream during launch. The results indicate that, if a configuration similar to the one considered is used for applications where supersonic airflows are encountered, a very careful flutter analysis is in order to insure that undesirable flutter characteristics are not present. IAA

N64-19155 France. Office National d'Etudes et de Recherches Aeronantiques, Chatillon-sous-Bagneux
ON THE BREATHING (FLEXURAL) VIBRATIONS OF THIN SHELLS. APPLICATION TO SOLID-ROCKETS [SUR LES VIBRATIONS DE RESPIRATION DES COQUES MINCES. APPLICATION AUX PROPULSEURS A COMBUSTIBLE SOLIDE]
Gabriel Coupry [Feb. 1964] 148 p refs In FRENCH; ENGLISH summary
(*Its* Publ. 110(1964))

The theory of vibrations applicable to shells of nonhomogeneous thickness when important static stresses occur is discussed. A generalization of the notion of natural modes, i.e., the study of the families of eigenfunctions, is developed; it provides a simpler means for solving the vectorial differential problems that are set forth. The tensor theory of nonhomogeneous shells, vibrating when prestressed, is developed. An attempt to apply this theory to the prediction of the vibrations, which may occur in the case of solid-rockets in operation, is presented. Theoretical predictions and various experimental results are compared. Author

N64-19157 Aerospace Corp., El Segundo, Calif. Systems Research and Development Div.
THERMOELASTIC DIFFERENTIAL EQUATIONS FOR SHELLS OF ARBITRARY SHAPE
John C. Yao 14 Jan. 1963 11 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-20; TDR-169(3560-30)TN-4; AD-299355)

Thermoelastic differential equations for shells of arbitrary shape are formulated in the form of Vlasov-type equations that contain the radial displacement and the Airy-type stress function as the dependent variables, and are expressed in terms of the general curvilinear coordinate system. Author

N64-19257* Lehigh U., Bethlehem, Pa. Inst. of Research
SOME STATISTICAL ASPECTS OF FATIGUE FAILURE THROUGH CRACK PROPAGATION
E. J. Brown and J. R. Rice 10 Feb. 1964 24 p refs
(NASA Grant NsG-410)
(NASA CR-53516) OTS: $2.60

Development of the elements of a statistical approach to fatigue failure through an analysis of growth of fatigue-cracks-to-final-failure is discussed. It is assumed that the loadings experienced by the cracked body and its material properties are random. Using concepts of fracture mechanics and a fracture-mechanics approach to fatigue-crack propagation, expressions are developed for the probability that a cracked body will survive a given period of loading without catastrophic failure. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-18680 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL DAMPING OF OSCILLATIONS OF THIN-WALLED SHELLS OF TYPE OF HOUSING COMPONENTS OF GAS TURBINE ENGINES
A. M. Soyfer and V. P. Filekin 6 Dec. 1963 14 p Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (USSR), no. 1, 1958 p 158–164
(FTD-MT-63-131; AD-434995)

Damping effect is created using natural elements of the structure. Damping is obtained by means of external resistances appearing in compound elements of the structure of by forces of resistance distributed along the surface of elements of the structure. These principles were applied to the case of thin-walled welded bodies of gas-turbine engines. For experimental purposes, a two-layer shell was made of sheet material in the form of concentric thin-walled cylinders. The resistances appearing between the shell layers at points of contact produce the desired damping effect. It was concluded that the resonance amplitude of a two-layer shell is 20% to 28% less than for a single-layer shell over a wide range of resonant frequencies. E.W.

N64-18741 Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.
DESIGN, DEVELOPMENT AND FABRICATION OF ULTRA-HIGH STRENGTH SOLID PROPELLANT ROCKET MOTOR CASES Quarterly Progress Report No. 3, 20 Nov. 1963-20 Feb. 1964
V. Crane, E. P. Gilewiez et al [1964] 43 p ref
(Contract AF 04(611)-9064)
(WADR-407-3; AD-433809)

The objective of this program is to test the capabilities of maraging steel at a minimum uniaxial yield-strength level of 280,000 psi. The test-inspection results on all details are presented. The metallurgical heat-treat optimization program results are also reported. The status of the first rocket motor case is reviewed, and the hydrotest plan for this case is presented in detail. R.T.K.

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